

E
TECHNICAL
SPECIFICATIONS

SECTION E

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CITY OF LACEY

LIFT STATION 11

IMPROVEMENTS PROJECT

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SECTION 26 05 00

GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies general requirements applicable to all electrical work to be completed at the facility. This may include such things as underground conduit, surface conduit, motors, control components and similar.
- B. Section includes:
 - 1. Scope
 - 2. Definitions
 - 3. Reference Standards
 - 4. Quality Assurance
 - 5. Submittals
 - 6. Drawings
 - 7. Project Site Conditions
 - 8. Equipment Coordination
 - 9. Basis of Design
 - 10. Products
 - 11. Execution – General
 - 12. Testing

1.2 SCOPE

- A. This section specifies general requirements for electrical work. Detailed requirements for specific electrical items are specified in other sections but are subject to the general requirements of this section.
- B. Related Sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
- C. Interfaces to Equipment, Instruments, and Other Components:

1. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers, which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.
 2. Provide all material and labor needed to install the actual equipment furnished. Include additional conduit, wiring, terminals, or other electrical hardware to the work, which may be necessary to make a complete functional installation, based on the actual equipment furnished:
 - a. Make all changes necessary to meet the manufacturer's wiring requirements.
 3. Submit all such changes and additions for acceptance in accordance with requirements of the City of Lacey Section D: Special Provisions and the Standard Specifications.
 4. Review the complete set of Drawings and Specifications in order to ensure that all items related to the electrical power and control systems are completely accounted for. Include items that appear on Drawings or in Specifications from another discipline in the scope of Work:
 - a. If a conflict between Drawings and Specifications is discovered, refer conflict to the Engineer as soon as possible for resolution.
- D. All electrical equipment and systems for the entire project shall comply with the requirements of Division 26, whether referenced in the individual equipment specifications or not:
1. The requirements of Division 26 apply to all electrical work specified in other Divisions and Sections, Control Panels (CPs), Instruments, and other electrical enclosures.
 2. The City is not responsible for any additional costs due to the failure of the Contractor to notify all Subcontractors and suppliers of the Division 26 requirements.
- E. Contract Documents:
1. General:
 - a. The Drawings and Specifications are complementary and are to be used together to fully describe the Work.
 2. Contract Drawings:

- a. The electrical Drawings show in a diagrammatic manner, the desired locations, and arrangements of the components of the electrical work. Follow the Drawings as closely as possible. Use professional judgment and coordinate with the other trades to secure the best possible installation. Use the entire Drawing set for construction purposes.
- b. Locations of equipment, control devices, instruments, boxes, and panels are approximate only, exercise professional judgment in executing the Work to ensure the best possible installation:
 - 1) The equipment locations and dimensions shown on plans and elevations are approximate. Use the Shop Drawings to determine the proper layout, foundation, and pad requirements for final installation. Coordinate with all Subcontractors to ensure that all electrical equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.
 - 2) The Contractor has the freedom to select any of the named manufacturers, as identified in the individual specification sections. The Engineer has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the Contractor's responsibility to ensure that the equipment being furnished fits within the defined space.
- c. Installation Details:
 - 1) The Contract Drawings include typical installation details, which show the means and methods the Contractor is to use to install electrical equipment. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work, and submit these details for review by the Engineer.

F. Utility Coordination:

- 1. The Contractor shall coordinate with the local electric Utility for the installation of the electrical service at the City's facility as specified in section 26 05 85 and comply with the City of Lacey Section D: Special Provisions.

1.3 DEFINITIONS

- A. **WIRING, ELEMENTARY OR SCHEMATIC DIAGRAM:** A schematic (elementary) diagram shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.

- B. ONE-LINE DIAGRAM: A one-line diagram shows by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and the components, devices or parts used therein. Physical relationships are usually disregarded.
- C. BLOCK DIAGRAM: A block diagram is a diagram of a system, instrument, computer, or program in which selected portions are represented by annotated boxes and interconnecting lines.
- D. CONNECTION DIAGRAM: A connection diagram includes all of the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly. This diagram shall be (a) in a form showing interconnecting wiring only by terminal designation (wireless diagram), or (b) a panel layout diagram showing the physical location of devices plus the elementary diagram.
- E. INTERCONNECTION DIAGRAM:
 - 1. Interconnection diagrams shall show all external connections between terminals of equipment and outside points, such as motors and auxiliary devices. References shall be shown to all connection diagrams which interface to the interconnection diagrams. Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry/exit of the individual wires clearly shown. Wireless diagrams and wire lists are not acceptable.
 - 2. Each wire identification as actually installed shall be shown. The wire identification for each end of the same wire shall be identical. All devices and equipment shall be identified. Terminal blocks shall be shown as actually installed and identified in the equipment complete with individual terminal identification.
 - 3. All jumpers, shielding and grounding termination details not shown on the equipment connection diagrams shall be shown on the interconnection diagrams. Wires or jumpers shown on the equipment connection diagrams shall not be shown again on the interconnection diagram. Signal and DC circuit polarities and wire pairs shall be shown. Spare wires and cables shall be shown.
- F. ARRANGEMENT, LAYOUT, and/or OUTLINE DRAWINGS: An arrangement, layout, and or outline drawing is one which shows the physical space and mounting requirements of a piece of equipment. It may also indicate ventilation requirements and space provided for connections or the location to which connections are to be made.

1.4 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NECA-1	National Electrical Contractors Association – Standard Practices for Good Workmanship in Electrical Contracting
NFPA-70 NFPA-70E	National Electrical Code (NEC) Electrical Safety in the Workplace
NEMA	National Electrical Manufacturers Association
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IBC	International Building Code
WAC	Washington Administration Code

1.5 QUALITY ASSURANCE

A. IDENTIFICATION OF LISTED PRODUCTS:

1. Electrical equipment and materials shall be listed for the purpose for which they are to be used, by an independent testing laboratory. Three such organizations are Underwriters Laboratories (UL), Factory Mutual (FM), and Electrical Testing Laboratories (ETL). Independent testing laboratory shall be acceptable to the inspection authority having jurisdiction.
2. When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority, to undergo inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price. Contractor shall comply with Washington Administrative Code regulations concerning Listing requirements for electrical equipment.

- B. **FACTORY TESTS:** Where specified in the individual product specification section, factory tests shall be performed at the place of fabrication and performed on completion of manufacture or assembly. The costs of factory tests shall be included in the contract price.

C. HANDLING AND STORAGE:

1. In accordance with the WSDOT Standard Specification Section 1-06.4.

1.6 SUBMITTALS

A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.

- c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.
4. Provide Seismic calculations for anchoring and support of equipment as required.
5. Interconnection diagram: The Contractor shall prepare interconnection diagrams depicting all cable requirements together with their actual terminations as specified.
6. Safety disconnect switch list including legend with equipment tag, equipment description, and power feeder circuit source and location information.
7. Maintenance Data: For all equipment and for components to include in maintenance and service manuals specified in City of Lacey Section D: Special Provisions Section 7-22.3(3)B.
8. Manufacturer's written instructions for testing, adjusting and troubleshooting.

1.7 WARRANTY

- A. Provide a written warranty covering the work done under this Division as required by the General Conditions.
- B. Apparatus:
 1. Free of defects of material and workmanship and in accord with the Contract Documents.
 2. Built and installed to deliver its full rated capacity at the efficiency for which it was designed.
 3. Operate at full capacity without objectionable noise or vibration.
- C. Systems: Any system damage caused by failures of any system component shall be included.

1.8 DRAWINGS

- A. Where the Contractor is required to provide information on drawings as part of the specified work, such drawings shall be prepared on 11-inch by 17-inch paper, and on USB drive in AutoCAD or DXF file format. Drawings shall be complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing. Drawing quality and size of presentation shall be such as to permit 50 percent

reduction of such drawings for insertion in operation and maintenance manuals. Drawings deemed illegible shall be rejected.

- B. Where the Contractor is required to provide equipment or system submittal information on drawings as part of the specified work, such drawings shall be prepared on 11-inch by 17-inch paper and shall be included in PDF format. Drawings shall be complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing. Drawing quality and size of presentation shall be such as to permit 50 percent reduction of such drawings for insertion in operation and maintenance manuals. Drawings deemed illegible shall be rejected.

1.9 PROJECT/SITE CONDITIONS

- A. GENERAL: Unless otherwise specified, equipment and materials shall be sized and derated for the ambient condition of 40 degrees C at an elevation ranging from sea level to 500 feet without exceeding the manufacturer's stated tolerances.
- B. HAZARDOUS (CLASSIFIED) AREAS: The wet well, valve vault, and cable trench areas are designated as 'Classified' in accordance with the NEC, NFPA 820. See drawings for locations and Class designations.
- C. SEISMIC: Electrical equipment supports, and anchorage shall be designed and installed in accordance to local regional seismic requirements.

1.10 ELECTRICAL NUMBERING SYSTEMS

- A. TAGGING: All circuit raceways shall be tagged at all terminations, panels, pull boxes, junction boxes, etc. in accordance with the assigned numbers on the circuit/raceway schedule and schematic/plan drawings. The tags shall be installed in a clean and high workmanship manner. In addition to tags at the terminations, exposed raceways shall be tagged at each side of concealment.
- B. PREFIX MODIFIERS: The following prefix modifiers shall be used when scheduling/tagging cables and raceway:

Raceway Prefix	Type of Function
H	Power above 600V
P	Power 120V to 600V
C	Control or power - 120V or less
S	Low level signal (less than 90-volt communication or less than 30-volt instrumentation)
D	Data
PC	Composite of power 120 to 600V and control

F	Optical Fiber
PSP, CSP	Spare power, spare control

1. Examples of raceway numbering for the project are:

- a. P-M: Conduit from main control enclosure to isolation pedestal for pump 1 power circuit.
- b. S-C: Conduit from main control enclosure to isolation pedestal for level transducer circuit.

C. RACEWAY NUMBERS: Where circuit/raceway numbers have not been assigned, Contractor shall assign raceway numbers in accordance with the system outlined in the drawings.

1.11 CONDUCTOR NUMBERS:

- A. WIRE MARKERS: All control and signal conductors in panels, pull boxes, power, instrument, and relay compartments of motor control centers, control cabinets, instrument cabinets, field cabinets and control stations, as well as connections to mechanical equipment, shall be tagged at each end with legible, coded tight-fitting wire-marking sleeve showing the complete wire designation. The letters and numbers that identify each wire shall be machine printed on sleeves with permanent black ink. The sleeves shall be shrunk to fit the conductor with hot air after installation. Adhesive strips are not acceptable.
- B. INTERNAL WIRING: Wiring shall have the same descriptions, to the greatest extent, as the projects original drawings. Wiring shall have labels at each end.
- C. FIELD WIRING: Wiring shall have the same descriptions, to the greatest extent, as the projects original drawings. Wiring shall have labels at each end.

1.12 INDICATING LAMP COLORS

- A. All indicating lamps shall have an integrated lamp-test function.
- B. Unless otherwise specified, indicating lights shall be equipped with colored lenses in accordance with the following schedule:

Color	Function	Example
Blue	Normal condition, Ready	Control power on, status OK
Red	Abnormal, alarm	High wet well level

1.13 EQUIPMENT COORDINATION

- A. The Contractor is responsible to coordinate the equipment supplied from various manufacturers and vendors. This includes but is not limited to:
 - 1. Obtaining specific information on equipment ratings and sizes and verifying the electrical components supplied meet, or match the requirements such as voltage, phase, frequency, starter types, etc.
 - 2. Shall provide equipment that will fit within the space allocated and meet OSHA and NEC clearances.
 - 3. Shall provide coordinated electrical installations with the supplied equipment's electrical power and control requirements.
 - 4. Shall provide power and control equipment, wiring, and raceways to meet the requirements of the mechanical equipment supplied.
 - 5. Shall provide all necessary control wiring and components for any special requirements from an equipment manufacturer.

- B. The Contractor shall verify as a minimum:
 - 1. Correct voltage, phase and frequency
 - 2. Size and space requirements
 - 3. Mounting requirements
 - 4. Correct motor starter type and NEMA size
 - 5. Proper coordination with the controls and Facility Integrator

- C. Any discrepancies between the electrical equipment and other equipment shall be brought to the immediate attention of the Owner.

1.14 BASIS OF DESIGN

- A. The basis of the mechanical and electrical design is the installation of equipment and motors as shown in the electrical one-line drawing(s) and load/panel schedules. In the event that different equipment motors are provided in order for the vendor's equipment to meet mechanical performance requirements, the contractor shall coordinate various suppliers, vendors, and subcontractors to change the required electrical conduit, cables, breakers, starter units and accessories, etc. as necessary to meet the vendor's equipment installation requirements of the National Electrical Code. The traits and characteristics of all provided materials, equipment, and devices shall meet the specifications. These changes to materials, equipment, and devices shall be at no cost to the Owner. Electrical submittal information shall be coordinated with the equipment and motors provided.

1.15 TEMPORARY POWER

- A. Temporary power is not currently available to the project site. Contractor shall coordinate and provide temporary power at the project site when required and necessary. If temporary power is to be provided by the utility, the Contractor is responsible for coordinating and working with the utility for said connection.
- B. Contractor to coordinate installation of temporary power meter and disconnect near the existing transformer for operation and testing of the new station before final service connection is relocated from old station. Provide all temporary cabling as required.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. GENERAL: Equipment and materials shall be new and free from defects. All material and equipment of the same or a similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.
- B. EQUIPMENT FINISH: Unless otherwise specified, electrical equipment shall be painted with the manufacturer standard ANSI 61 grey.
- C. GALVANIZING: Where specified, galvanizing shall be in accordance with WSDOT Standard Specifications Division 9: Materials.

2.2 WIRE MARKERS

- A. Each power and control conductor shall be identified at each panel or equipment terminal to which it is connected. All conductors shall have heat shrinkable identification sleeves.
- B. Conductors shall be identified in accordance with Section 26 05 00. Adhesive strips are not acceptable.
- C. The letters and numbers that identify each wire shall be machine printed on sleeves with permanent black ink with figures 1/8 inch high. Sleeves shall be yellow or white tubing and sized to fit the conductor insulation. Shrink the sleeves with hot air after installation to fit the conductor.
- D. Conductor and Wire Marker Manufacturer:
 - 1. TMS Thermofit Marker System by Raychem Co
 - 2. Sleeve style wire marking system by W. H. Brady Co.

3. Or approved equal

2.3 RACEWAY TAGS

- A. Tags shall be:
 1. Manufactured of permanent metal or heavy mill plastic.
 2. Fastened to the raceways at both ends of the tag with permanent fasteners.
 - a. Fastened to the raceways at both ends of the tag with permanent fasteners.
 3. Tag numbers shall be 1-inch tall and machine printed. Hand labeled tags are unacceptable.
 4. Tags for intrinsically safe conduits shall bear an additional tag labeled "I.S." or somehow designate that it contains intrinsically safe circuiting.

2.4 NAMEPLATES – PHENOLIC LEGENDS

- A. Nameplates shall be provided on all equipment as shown on the contract drawings. Electrical devices, including but not limited to panels, instruments, disconnect switches, indicating lights, control switches, meters, and all electrical equipment enclosures as shown.
- B. Nameplates shall also be provided on all electrical panel interior equipment, including but not limited to relays, circuit breakers, power supplies, terminals, contactors, and other devices.
- C. Equipment nameplates shall have both the equipment name and number.
- D. Nameplates shall be made of 1/16-inch-thick machine engraved laminated phenolic as shown on the contract documents Phenolic Legends sheet. Coloring, sizing and engraving shall be as shown on the contract document. Equipment requiring labeling and not shown on the contract phenolic legends sheet of the contract documents shall use this standard for labeling.
- E. Provide warning nameplates on all panels and equipment which contain multiple power sources. Lettering shall be white on red background.
- F. Nameplates for disconnect switches shall contain name and number as well as voltage, phases and colors of conductors.

2.5 VINYL LEGENDS

- A. Vinyl legends shall be provided on all equipment, both interior and exterior to panels as shown on the contract drawings.

- B. Sizing, coloring and printing shall be as shown on the Vinyl Legends sheet and shall be placed as shown on the contract drawings.

2.6 TERMINAL BLOCKS

- A. Terminal blocks shall be provided for use in the Main control cabinet and the individual panels interior to the main control cabinet, ie. Pump control panel and intrinsically safe relay panel.
- B. Terminal block shall also be provided for use in the Isolation pedestal.

PART 3 EXECUTION

3.1 GENERAL

A. CONSTRUCTION

1. The work under Division 26 shall be performed in accordance with these specifications.
2. Unless otherwise detailed or dimensioned, electrical layout drawings are diagrammatic. The Contractor shall coordinate the field location of electrical material or equipment with the work of other disciplines and subcontractors. Minor changes in location of electrical material or equipment made prior to installation shall be made at no cost to the Owner.
3. The Contractor shall perform core drilling and provide link seal on all conduit penetrations into below grade structures, ie. vaults and wet well.
4. All conduit to be PVC coated galvanized rigid. Exceptions to be flexible conduit for final connection to flowmeter and PVC conduit for utility service.

B. HOUSEKEEPING:

1. Electrical equipment shall be protected from dust, water and damage. The main control cabinet shall be wiped free of dust and dirt, kept dry, and shall be vacuumed on the inside within 30 days of acceptance of the work.
2. Before final acceptance, the Contractor shall touch up any scratches on equipment. Contractor shall thoroughly clean the scratch, primer, and apply manufacturer paint. Deeper scratches may require a light sanding to even out the surface before priming.
3. Electrical equipment temporarily exposed to weather, debris, liquids, or damage during construction shall be adequately protected.

C. ELECTRICAL EQUIPMENT LABELING:

1. Electrical equipment shall have field marked signs and labeling to warn qualified persons of the potential electric arc flash hazards per NEC Article 110.16 Flash Protection.
2. Electrical equipment shall have NFPA 70E labels installed stating the results of the Arc Flash analysis as specified in City of Lacey Section D: Special Provisions.
3. Electrical distribution equipment and utilization equipment shall be provided with field labels to identify the power source and the load as specified. Refer to NEC Article 110.22 for Identification of Disconnecting Means installation criteria. Specific information is required such as the equipment tag number and equipment description of both the power source and the load equipment.

D. MOTOR CONNECTIONS: Verify that the motors are coordinated with the pump disconnect receptacles and plugs provided for on the isolation pedestal including the horsepower, current, and voltage rating as well as the pump cabling size for sizing the accessory handle.

E. CONDUCTOR INSTALLATION: Other than the main control cabinet, an enclosure containing disconnecting means, overcurrent devices, or electrical equipment shall not be used as a wireway or raceway for conductors not terminating within the enclosure. Provide wireways, raceways, termination boxes, or junction boxes external to the enclosure for the other conductors.

3.2 HANDLING AND STORAGE

A. In accordance with the WSDOT Standard Specification Section 1-06.4.

3.3 TESTING

A. GENERAL: Prior to energizing the electrical circuits, insulation resistance measurements tests shall be performed using a 1000-volt megohmmeter to verify the conductor is acceptable for use on the project. The test measurements shall be recorded on the specified forms and provided in accordance with Section 26 08 00 and as listed below.

B. INSULATION RESISTANCE MEASUREMENTS:

1. GENERAL:

- a. Insulation resistance measurements shall be made on conductors and energized parts of electrical equipment (600V or less). Minimum acceptable values of insulation resistance shall be in accordance with the applicable ICEA, NEMA or ANSI standards for the equipment or material being tested, unless

otherwise specified. The ambient temperature at which insulation resistance is measured shall be recorded on the test form.

- b. Insulation resistance measurements shall be recorded. Insulation with resistance of less than 100 megohms is not acceptable.
 2. CONDUCTOR AND CABLE TESTS: The phase-to-ground insulation resistance shall be measured for all circuits rated 120 volts and above except lighting circuits. Measurements may be made with motors and other equipment connected. Solid state equipment shall be disconnected, unless the equipment is normally tested by the manufacturer at voltages in excess of 1000 volts DC.
 3. MOTOR TESTS: Installed motors shall be tested per Section 26 08 00 shall be completed for each motor after installation. Motors shall have their insulation resistance measured before they are connected. Motors 50 HP and larger shall have their insulation resistance measured at the time of delivery as well as when they are connected. Insulation resistance values shall be a minimum of 100 megohms; lower readings are not acceptable.
- C. PRE-FUNCTIONAL TEST CHECKOUT: Functional testing shall be performed in accordance with the requirements of Section 26 08 00. Prior to functional testing, all protective devices shall be adjusted and made operative.
1. Submit a description of the proposed functional test procedures prior to the performance of functional checkout.
 2. Prior to energization of equipment, perform a functional checkout of the control circuit. Checkout:
 - a. Energizing each control circuit.
 - b. Operating each control device, alarm device, or monitoring device.
 - c. Operate each interlock to verify that the specified action occurs.
- D. Verify motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation or momentary energization.

3.4 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable switches and circuit-breaker trip ranges.

C. Set field-adjustable time delay relays and seal fail reset switches.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.6 OPERATION AND MAINTENANCE MANUALS

A. Comply with City of Lacey Section D: Special Provisions Section 7-22.3(3)B.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE CONDUCTORS, WIRES AND CABLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Definitions.
 - 5. Submittals.
 - 6. Products.
 - 7. Execution.

1.2 SCOPE

- A. This section specifies cables, conductors and fibers including:
 - 1. Stranded copper cables, conductors, and wire rated 600 volts insulation used for power; lighting, analog, digital, or pulse signals and control circuits.
 - 2. Copper cables and coax cable rated 300-volt insulation used for data, communication, and signaling.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
 - 1. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that

organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ASTM B3	Soft or Annealed Copper Wire
ASTM B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ICEA S-95-658/ NEMA WC70	Non-shielded 0-2kV Cables
NFPA 70	National Electric Code (NEC)
UL 44	Rubber-Insulated Wires and Cables
UL 83	Thermoplastic-Insulated Wires and Cables

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from the date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 DEFINITIONS

- A. LOW LEVEL ANALOG: A signal that has a full output level of 100 millivolts or less. This group includes thermocouples and resistance temperature detectors.
- B. PULSE FREQUENCY: Counting pulses such as those emitted from speed transmitters.
- C. HIGH LEVEL ANALOG: Signals with full output level greater than 100 millivolts but less than 30 volts, including 4-20 mA transmission.
- D. DISCRETE EVENTS: Dry contact closures monitored by solid state equipment. If the conductors connecting to dry contacts enter enclosures containing power or control circuits and cannot be isolated from such circuits in accordance with NEC Article 725, this signal shall be treated as low voltage control.
- E. LOW VOLTAGE CONTROL: Contact closures monitored by relays, or control circuits operating at less than 30 volts and 250 milliamperes.

1.6 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - 3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

4. Catalog cuts showing information of the conductors and cables to be supplied under this section.
5. Field test reports showing conductor and cable insulation resistance test results.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers are listed in the Cable Specification Sheets located at the end of this specification section.

2.2 GENERAL

A. UNSCHEDULED CONDUCTORS AND CABLES:

1. With the exception of lighting and receptacle circuits, the type, size and number of conductors shall be as specified on the drawings or schedules. 120V panel circuit conductors mentioned above that are unscheduled and shall be sized by the Contractor in accordance with the breakers specified and the NEC to limit voltage drop to 3 percent. Minimum size of power, lighting, and receptacle circuits shall be 12 AWG. Number and types of communication, paging, and security cables shall be as required for the particular equipment provided.
2. Where not specified on the Drawings, conductors and cables shall be sized in accordance with the National Electrical Code for the particular equipment served with the minimum size as specified herein. Unscheduled conductors shall be sized by the Contractor in accordance with NEC tables and to limit voltage drop to 3 percent.

- B. CABLE SPECIFICATION SHEETS (CABLESPEC): General requirements for conductors and cables specified in this Section are listed on CABLESPEC sheets.

2.3 COLOR CODING

A. POWER AND CONTROL CABLES:

1. Wire coloring shall conform to the color code shown in the table below.
2. Insulation on phase conductors run in conduits sizes #10 AWG and smaller shall be colored, #8 AWG and larger may have black insulation with plastic tape of the appropriate color from the table below.

3. Insulation on the grounded conductor (neutral) sizes #8 AWG and smaller shall be colored, #6 AWG and larger may have black insulation with plastic tape of white or gray in accordance with the table below.

Description	120/208V	277/480V	Control
Phase A (Left)	Black	Brown	--
Phase B (Center)	Red	Orange	--
Phase C (Right)	Blue	Yellow	--
Neutral	White	Gray	White
Ground	Green	Green	Green
120 VAC Control	--	--	Red
120 VAC Control Neutral	--	--	White
24 VDC Control (+)	--	--	Dark Blue
24 VDC Control (-)	--	--	White-Blue Stripe
12 VDC Control (+)	--	--	Orange
12 VDC Control (-)	--	--	Yellow
Intrinsic Safe	--	--	Purple
Signal Ground	--	--	Green/yellow stripe

4. All control wiring in control panels or other enclosures that is powered from an external source and is not disconnected by the control panel disconnect shall be terminated at a disconnecting terminal block upon entering the enclosure. The color of the wire shall then be changed to yellow to identify it as being powered from an external source. Provide identification nameplate on exterior of enclosure to indicate sources of external power.
 5. All wiring in industrial machines and equipment shall be in accordance with NFPA 79. Notify owner of any deficiencies noted during installation.
 6. Multi-conductor power cable colors shall be manufacturer's standard.
 7. Cables sized No. 6 AWG and larger may be black with colored 3/4-inch vinyl plastic tape applied in 3-inch lengths around the cable at each end. The cables shall be tagged at terminations and in pull boxes, hand holes and manholes.
- B. SIGNAL AND DATA CABLES: Unless otherwise specified, cables shall be color coded black and white for pairs or black, red, and white for triads.

2.4 POWER AND CONTROL CONDUCTORS AND CABLE, 600 VOLT

- A. SINGLE CONDUCTOR: Single conductor cable shall be stranded copper and shall be used in conduits for power and control circuits. Single conductor cable shall be provided in accordance with CABLESPEC "THHN/THWN-2" type of conductors unless otherwise specified.

2.5 SIGNAL, DATA AND INSTRUMENTATION CABLES

A. GENERAL:

1. Signal cable shall be provided for instrument signal transmission, alarm, communication, and other circuits as specified. Circuit shielding shall be provided in addition to cable shielding.
2. Single circuit signal cable shall be provided in accordance with CABLESPEC "INS," unless otherwise specified.
3. Terminal blocks shall be provided at cable junction for running signal leads and shield drain wires. Each conductor shall be identified at such junctions.
 - a. Shields shall not be used as a ground path.
 - b. Shields shall be grounded at one end only. Ground at pump panel end.
 - c. Signal, data, and communication cables shall be terminated and spliced on terminal strips properly mounted and labeled in accordance with this Section and Section 26 05 00. No exceptions.
4. CABLE SPECIFICATION SHEETS (CABLESPEC): General requirements for conductors and cables specified in this Section are listed on CABLESPEC sheets in Section 26 05 19-3.7.

2.6 WIRE MARKERS

A. 600 VOLT AND 300 VOLT RATED CONDUCTORS:

1. Per 26 05 00 Paragraph 2.2.

2.7 SPLICING AND TERMINATING MATERIALS

A. 600-VOLT AND 300-VOLT RATED CONDUCTORS:

1. Connectors shall be tool applied compression type of correct size and UL listed for the specific application. Connectors shall be tin-plated high conductivity copper. Connectors for wire sizes No. 10 AWG and smaller shall be nylon self-insulated, ring tongue or locking-spade terminals. Connectors for wire sizes No. 8 AWG and larger

shall be one-hole lugs up to size No. 3/0 AWG, and two-hole or four-hole lugs for size No. 4/0 and larger. Mechanical clamp, dimple, screw-type connectors are not acceptable.

2. In-line splices and taps shall not be used. All circuits shall be continuous through all junction boxes, wireways, pull boxes, etc. until the circuit conductors are terminated at suitable terminal strips within motor control centers, PLC cabinets and panels, distribution panels, local control stations, etc.

2.8 CORD GRIPS

- A. Cord grips shall be provided where specified on the Drawings to attach flexible cord to equipment enclosures. Cord grips shall consist of a threaded aluminum body and compression nut with a neoprene bushing and stainless-steel wire mesh for strain relief. Cord grip shall provide a watertight seal at enclosure interface and sized to accommodate the flexible cord.

PART 3 EXECUTION

3.1 GENERAL

- A. Conductors shall be identified at each connection terminal and at splice points. The identification marking system shall comply with Section 26 05 00.
- B. Pulling wire and cable into conduit or trays shall be completed without damaging or putting undue stress on the insulation or jacket. Manufacture recommended and UL Listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable.
- C. Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed. Where wire or cable exits a raceway, a wire or cable support shall be provided.
- D. Provide tin-plated bus bar. Scratch-brush the contact areas and tin plate the connection where flat bus bar connections are made with un-plated bar. Bolts shall be torqued to the bus manufacturer's recommendations.

3.2 600-VOLT CONDUCTOR AND CABLE

- A. Conductors in panels and electrical equipment shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing is not necessary in plastic panel wiring duct or wall mounted steel raceway used above countertops. Lacing shall be made up with plastic cable ties. Cable ties shall be tensioned and cut off by using a tool specifically designed for the purpose such as a Panduit GS2B. Other methods of cutting cable ties are unacceptable.

- B. Conductors crossing hinges shall be bundled into groups not exceeding 10 to 15 conductors and protected using nylon spiral flexible covers to protect conductors. Provide oversized plastic panel wiring duct within panels and panelboards.
- C. Slack shall be provided in junction and pull boxes, hand holes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls. Amount of slack shall be equal to largest dimension of the enclosure. Provide dedicated electrical wireways and insulated cable holders mounted on unistrut in manholes and hand holes.
- D. Raceway fill limitations shall be as defined by NEC.
- E. Motor terminations shall be made with manufacturer's cabling wired to pump power plugs connecting to the Isolation pedestal panel. Motor wiring from controller shall be terminated on terminal strips provided interior to the Isolation pedestal panel.

3.3 SIGNAL CABLE

- A. Circuits shall be run as individually shielded twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever 3-wire circuits are required. Terminal blocks shall be provided at instrument cable junctions, and circuits shall be identified at such junctions unless otherwise specified. Signal circuits shall be run without splices between instruments, terminal boxes, or panels.
- B. Shields shall not be used as a signal conductor.
- C. Common ground return conductors for two or more circuits are not acceptable.
- D. Unless otherwise specified, shields shall be bonded to the signal ground bus at the control panel and isolated from ground and other shields at other locations. Terminals shall be provided for running signal leads and shield drain wires through junction boxes.
- E. Cable for low-level instrumentation circuits shall be run continuously between final terminations without splices or intermediate terminal blocks unless otherwise specifically shown or specified.
- F. Spare circuits and the shield drain wire shall be terminated on terminal blocks at both ends of the cable run and be electrically continuous through terminal boxes. Shield drain wires for spare circuits shall not be grounded at either end of the cable run.
- G. Terminal boxes shall be provided at instrument cable splices. If cable is buried or in raceway below grade at splice, an instrument stand shall be provided as specified with terminal box mounted approximately 3 feet above grade.

3.4 INSTALLATION

- A. Raceway fill shall be as scheduled, and shall not exceed NEC limitations.
- B. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:
 - 1. Where specifically indicated on the drawings.
 - 2. Where field conditions dictate and written permission is obtained from the Owner.
 - 3. Control circuits shall be isolated from the feeder and branch power and instrumentation circuits but combining of control circuits with power is permitted as noted below.
 - a. The combinations shall comply with the following:
 - 1) 12 VDC, 24 VDC and 48 VDC may be combined.
 - 2) All AC circuits shall be isolated from all DC circuits.
 - 3) All intrinsically safe circuits shall be separated from other circuits by placing them in separate conduit or a 2" separation of air space.
 - 4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.
 - a. The combinations shall comply to the following:
 - 1) Analog signal circuits may be combined.
 - 2) Digital circuits may be combined but isolated from analog signal circuits.
 - 5. Multiple branch circuits for lighting, receptacle and other 120 VAC circuits are allowed to be combined into a common raceway.
 - a. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NEC, including but not limited to:
 - 1) Up sizing conductor size for required Ampacity de-ratings for the number of current-carrying conductors in the raceway.
 - 2) The neutral conductors may not be shared.
 - 3) Up sizing raceway size for the size and quantity of conductors.

- C. Pulling wire and cable into conduit or cable trays shall be completed without damaging or putting undue stress on the cable insulation. Only UL listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable. Raceway construction shall be complete, cleaned, and protected from the weather before cable is placed.
- D. Whenever a cable leaves a raceway, a cable support shall be provided. Conductors in panels and electrical equipment shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing shall be made up with plastic cable ties. Lacing is not necessary in plastic panel wiring duct. Conductors crossing hinges shall be bundled into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.
- E. Slack shall be provided in junction and pull boxes, hand holes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls of the box. Amount of slack shall be equal to largest dimension of the box. Where plastic panel wiring duct is provided for wire runs, lacing is not required. Plastic panel wiring duct shall not be used in manholes and hand holes.
- F. Do not exceed cable manufacturer's maximum recommended pulling tension. Use dynamometer or break-away swivel on pulls exceeding 150 feet.
- G. Observe manufacturer's minimum recommended pulling and training radii.
- H. At each end of the run leave sufficient cable for termination. Coil sufficient cable in each manhole, handhold, or pull box to permit future splice.
- I. In-line splices and tees are not allowed.
- J. Ground cable shields at one end only. Unless otherwise specified, ground the shields at the panel end.
- K. Protect all cables against moisture during and after installation.
- L. Signal and control cable suspended into the wet well shall be provided with heavy duty wire mesh cord grip of flexible stainless-steel wire to take the tension from the cable termination. Strain relief system shall be suitably anchored. See contract drawings for additional information.
- M. Circuits provided under this Section shall not be direct buried.

3.5 TERMINATIONS

- A. Terminations shall be on terminators as identified in Section 26 05 00.

- B. Each conductor shall be identified with a wire marker at each terminal to which it is connected. The marking system shall comply with Section 26 05 00.
- C. Stranded conductors shall be terminated as described in Section 26 05 19, except where terminals will not accept such terminations. Compression lugs and connectors shall be installed using manufacturer's recommended tools. Where terminal blocks will not accept lugged conductors, the conductors shall be tinned using 60 percent tin, 40 percent lead alloy non-corrosive resin core solder before insertion into pressure terminals.
- D. Electrical spring connectors (wire nuts) shall not be used for any purpose on any cable specified under this Section except for receptacle and lighting circuits. Lugs and connectors shall be installed with a compression tool.
- E. All splices and terminations are subject to inspection by the Owner prior to and after insulating.
- F. Terminations at solenoid valves, 120-volt motors, and other devices furnished with pigtail leads shall be made using self-insulating forked compression connectors and terminal strips within a termination/junction box.
- G. Conductor and cable markers shall be provided at splice points.

3.6 TESTING

A. GENERAL:

1. The Contractor shall test conductors and cable in accordance with Section 26 08 00. Instrument and Data Cables shall be subjected to additional tests as specified in this section.

B. INSTRUMENT CABLE:

1. Each signal pair or triad shall be tested for electrical continuity. Any pair or triad exhibiting a loop resistance of less than or equal to 50 ohms shall be deemed satisfactory without further test. For pairs with greater than 50-ohm loop resistance, the Contractor shall calculate the expected loop resistance considering loop length and intrinsic safety barriers if present. Loop resistance shall not exceed the calculated value by more than 5 percent.
2. Each shield drain conductor shall be tested for continuity. Shield drain conductor resistance shall not exceed the loop resistance of the pair or triad.
3. Each conductor (signal and shield drain) shall be tested for insulation resistance with all other conductors in the cable grounded.

4. Instruments used for continuity measurements shall have a resolution of 0.1 ohms and an accuracy of better than 0.1 percent of reading plus 0.3 ohms. A 500-volt megohmmeter shall be used for insulation resistance measurements.

3.7 CABLE SPECIFICATIONS

A. GENERAL: Conductor, wire, and cable types for different locations, service conditions and raceway systems are specified on individual cable specification sheets. Scheduled and unscheduled conductors, wires, and cables shall be installed in accordance with the CABLESPEC SHEETS.

B. CABLE SPEC SHEETS: The following CABLE SPEC sheets are included in this section:

CABLESPEC	Volts	Product	Purpose
THHN/THWN-2	600	Single conductor PVC, nylon jacket power and control cable	Power and control conductors for use in conduit raceways.
CORD	600	Rubber Jacketed multi-conductor cable.	Temporary power cable.
INS	600	Single Pair/Triad #18 ST plus overall shield,	Instrumentation
NC2	300	Category 5e Ethernet cable, 4 pairs, non-armored	Gigabit Ethernet cable

CABLE SPECIFICATION SHEETS (CABLESPECS) begin on next sheet:

Cable System Identification: THHN/THWN-2

Description:	Single conductor polyvinyl chloride (PVC), nylon jacket power and control cable for sizes No. 14 AWG and larger.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded in accordance with ASTM B3 & B8
Insulation:	Heat and moisture resistant colored polyvinyl chloride, 90 degree C dry, 90 degree C wet, in accordance with ICEA S-95-658/NEMA WC70.
Jacket:	Nylon or UL-listed jacket.
Manufacturer(s):	Southwire, Cerrowire, Encore Wire
Uses Permitted:	Power, control, lighting, receptacle and appliance circuits
Installation:	Install in accordance with Section 26 05 19.
Testing:	Test in accordance with this Section and Sections 26 05 00 and 26 08 00.

Cable System Identification: CORD

Description: Portable Cord, 3-conductor with ground, extra hard usage, oil, weather and water resistant. 10 AWG and smaller, UL listed, type SOOW; larger than 10 AWG, UL listed type G

Voltage: 600 volts

Conductor Material: Type G - Flexible rope lay stranded per ASTM B189 and B33. Type SOOW – Soft bare annealed copper per ASTM B-3, flexible bunch strand per ASTM B-174.

Insulation: Insulation shall be ethylene propylene (EPR) as per ICEA S-68-516 and rated for continuous operation at 90 degrees C.

Jacket: Black chlorinated polyethylene (CPE) rubber ICEA S-98- 658.

Manufacturer(s): Type SOOW - Houston Wire HW250, Southwire Viper, or approved equal. Type G – Houston Wire HW258, Southwire Type G, or approved equal,

Installation: Install in accordance with Section 26 05 19.

Testing: Test in accordance with Sections 26 05 19 and 26 08 00.

Sizing Cables: Cables shall be sized for loads to be served.

Cable System Identification: INS

Description: Single twisted, shielded pair or triad, 18 AWG, instrumentation cable, rated for wet and dry locations.

Voltage: 600 volts

Conductor Material: Bare annealed copper; stranded in accordance with ASTM B8

Insulation: PVC/Nylon

Shield: 100 percent, 1.35 mil aluminum-Polyester tape with 20 AWG 7-strand tinned copper drain wire

Jacket: 48 mil flame-resistance polyvinylchloride

Flame Resistance: UL 1685, ICEA T-29-520 and IEEE 1202.

Manufacturer(s): Single Pair: BELDEN 1120A, or approved equal. Single Triad: BELDEN 1121A, or approved equal.

Installation: Install in accordance with Section 26 05 19.

Testing: Test in accordance with this Section and Sections 26 05 00 and 26 08 00.

Cable System Identification: NC2

Description: Paired – DataTwist Enhanced Category 5e, gigabit Ethernet, 100BaseTX, 4 pair cable, non-armored

Voltage: 300V rms

Conductor Material: Tinned copper 24 AWG

Insulation Material: Polyolefin (PO)

Shield: Unshielded

Jacket: Polyvinyl chloride (PVC), 0.220-inch diameter

Flame Resistance: UL 1685

Electrical Characteristics: 350 MHz, 53.2 dB/100 meters

Manufacturer(s): Belden 1752A, Okonite, or approved equal.

Uses Permitted: Conduit. Execution:

Application: Data Network Communications – Ethernet.

Installation: Install in accordance with this Section and associated equipment manufacturer's instruction.

Testing: Test in accordance with this Section.

END OF SECTION

SECTION 26 05 26
GROUNDING SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. System Requirements.
 - 5. Sizing.
 - 6. Submittals.
 - 7. Products.
 - 8. Execution.

1.2 SCOPE

- A. This section specifies the system for grounding electrical distribution and utilization equipment, including but not limited to cabinets, motor frames, manholes, instrumentation, metal surfaces of process/mechanical equipment that contain energized electrical components, metal structures and buildings, outdoor metal enclosures, fences and gates.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE Std 81.2-1991	Guide to Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems
NETA - ATS	InterNational Electrical Testing Association Inc. - Acceptance Testing Specifications
NFPA 70	National Electric Code (NEC) Article 250

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SYSTEM REQUIREMENTS

- A. Provide equipment grounding conductors in all electrical raceways. The conductors shall be sized in accordance with the National Electrical Code.
- B. Provide main bonding jumper and grounding electrode conductor at incoming service entrance equipment. The conductors shall be sized in accordance with the National Electrical Code.
- C. Bond equipment pad rebar and grounding rods to form a ground mat. Bond all site ground mats via exothermic weld or hydraulically die crimped cold weld.

1.6 SIZING

- A. The minimum size of the Equipment Grounding Conductors installed with the circuit conductors shall be per the National Electrical Code Table 250.122. The circuit grounding conductor size routed with a feeder or branch circuit conductors is as shown on the drawings.
- B. The minimum size of the Grounding Electrode Conductor shall be per the National Electrical Code Table 250.66.

1.7 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.

B. ACTION SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Marked product literature for ground rods, test wells, and equipment ground bars.
4. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.
5. Grounding system test data.

PART 2 PRODUCTS

2.1 PROCESS EQUIPMENT GROUNDS

- A. The Contractor shall coordinate with the equipment supplier to provide an equipment ground lug and contractor provided ground cable and terminations to bond the equipment to the grounding electrode system. Ground cable shall be sized in accordance with this specification. Provide cables, exothermic welds, hydraulic die crimp connections and equipment bolted connections as necessary.

2.2 GROUNDING ELECTRODE AND BONDING CONDUCTORS

- A. Grounding electrode conductors, bonding conductors and bonding jumpers shall be soft-drawn, bare annealed copper, concentric stranded, as specified. The minimum sizes shall be as required by the National Electrical Code.

2.3 GROUND RODS

- A. Ground rods shall be copper covered steel, 3/4-inch diameter and 10-feet long. Rods shall have threaded type removable caps so that extension rods of same diameter and length may be added where necessary.

2.4 CONNECTORS

- A. COMPRESSION CONNECTORS: Compression connections shall be irreversible, cast copper as manufactured by Thomas and Betts, or approved equal.
- B. BOLTED CONNECTORS: Bolted connectors shall be Burndy, O. Z. Gedney, Thomas and Betts, or approved equal.
- C. EXOTHERMIC WELDED CONNECTORS: Exothermic welding products shall be Erico's Cadweld Plus system with a remotely operated battery powered electronic ignition device and moisture resistant weld metal cup for the required mold, or approved equal.
- D. COLD WELDED CONNECTORS: Hydraulically die crimped cold weld connectors shall be cast copper compression cross grid type as manufactured by Burndy, or approved equal.

2.5 TEST WELLS

A. CONCRETE BOXES

1. Material: High density reinforced concrete box with non-settling shoulders positioned to maintain grade and facilitate back filling with steel checker plate screw down cover.

2. Product and Manufacturer: Provide box assembly from one of the following:
 - a. Concrete Box: Christy Concrete Products, Inc. Model #F08 or as approved.
 - b. Concrete Cover: Christy Concrete Products, Inc. Model #F08R labeled "GROUND" or as approved.
- B. EXTERIOR TEST WELL: Provide concrete test well with cover and connect the ground grid extension using a removable connector.

2.6 MAIN GROUND BAR

- A. Main ground bar shall be provided in Main Control Cabinet and shall be used for grounding of breaker panel, ATS, TVSS and transformer bonding.
- B. Material: electrolyte copper, tin plated.
- C. Ground bar shall have a minimum of 6 port connection with connection for wires ranging from 14 AWG to 4 AWG.
 1. Product and Manufacturer: Panduit UGB2/0-414-6 per contract drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Embedded and buried ground connections shall be made by exothermic or irreversible cold weld connectors. Above grade ground connections shall be made by exothermic weld or by utilizing diamond or hexagon dies and a hand compression tool for wire sizes 2 AWG and smaller and a hydraulic pump and compression head for wire sizes 2/0 AWG and larger. Tools and dies shall be approved for this purpose; dimple compressions are not acceptable. Compression connections shall be prepared in accordance with the manufacturer's instructions. Exposed ground connections to equipment shall be made by bolted clamps unless otherwise specified. No solder shall be used in any part of the ground circuits.
- B. Embedded ground cables and fittings shall be exothermically or cold weld bonded to concrete reinforcing steel. Ground wires shall also be securely attached to concrete reinforcing steel with tie wires and prevented from displacement during concrete placement.
- C. Grounding conductors, which are extended beyond concrete surfaces for equipment connection, shall be extended a sufficient length to reach the final connection point without splicing. Minimum extension shall be 3 feet. Grounding conductors, which project from a concrete surface, shall be located as close as possible to a corner of the

equipment pad, protected by non-metallic conduit, or terminated in a flush grounding plate. Exposed grounding conductors shall be supported by noncorrosive metallic hardware at 4-foot intervals or less. Grounding conductors for future equipment shall be terminated using a two-hole copper flush mounted grounding plate.

- D. Ground conductors, except signal conductor shields, entering enclosures shall be bonded together to the enclosure if it is metallic and to metallic raceways within or terminating at the enclosure. Prior to making ground connections or bonds, the metal surface at the point of connection shall be cleaned.
- E. Compression-type lugs shall be used in accordance with manufacturer's recommendations.
- F. Grounding conductor shall not be used as a system neutral.
- G. Surge arresters shall be directly connected to the ground system using copper conductors, sized as recommended by the mfr.
- H. Metallic sheaths or shields of shielded power cable shall be terminated by a copper grounding strip provided with cable connection for connection to the grounding system.
- I. Furnish an equipment grounding conductor in all conduit runs sized in accordance with the NEC.
- J. Grounding system shall be provided in compliance with the NEC.

3.2 RACEWAY GROUND

- A. All service, feeder and branch circuit raceways shall contain a green insulated ground conductor sized per applicable NFPA 70 National Electrical Code (NEC) tables:
 - 1. T250.66 - Grounding Electrode Conductor for Alternating-Current Systems or
 - 2. T250.122 - Minimum Size Equipment Grounding Conductors for Grounding Raceways and Equipment.
- B. Metallic conduits terminating at concentric knock-outs or reducing washers shall be bonded using insulated grounding bushings. Grounding bushings shall be connected to the grounding system using conductors sized in compliance with NEC.
- C. Provide equipment grounding conductors in all power and control circuit raceways.

3.3 EQUIPMENT AND ENCLOSURE BONDING

- A. Electrical distribution and utilization equipment enclosure ground bus, motor frames, manholes, metal structures and buildings, outdoor metal enclosures, fences and gates shall be bonded to the grounding system with conductor sizes as specified.
- B. Connect the conductor to the metal enclosure using a UL listed connector, where the enclosure does not contain an internal ground bus.

3.4 SERVICE AND SEPARATELY DERIVED SYSTEM BONDING

- A. A neutral bonding jumper shall be installed in only one location for each service or separately derived system. The bonding jumper shall be located at the service source or the first immediate distribution point downstream from the source. The neutral and ground buses shall be kept isolated from each other except where the bonding jumper is installed.

3.5 GROUNDING SYSTEM TESTS

- A. The Contractor shall test the facility grounding system to determine the ground resistance.
 - 1. Ground resistance reading for each major piece of equipment connected to the main ground bar shall be tested, recorded and submitted on 8-1/2 x 11-inch size paper or in spreadsheet form, printed to a PDF file. Point-to-point resistance measurements are acceptable.
 - 2. The grounding electrode system shall be tested for ground resistance using a CE or ETL certified clamp on or connector ground tester.
 - 3. All readings shall have a maximum measurement of 20-ohms or shall meet any national, local, or authorities having jurisdiction requirements.
 - 4. The Contractor shall add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurements meet the 20-ohm requirement.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope
 2. Reference Standards
 3. Quality Assurance
 4. Submittals
 5. Products
 6. Execution

1.2 SCOPE

- A. This Section specifies requirements for design, furnishing and installation of support systems for electrical raceways, cables and enclosures.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI C80.1	Rigid Steel Conduit-Zinc Coated
ANSI C80.3	Electrical Metallic Tubing-Zinc Coated
ASTM A48 REV A	Gray Iron Castings
ASTM F512	Smooth-Wall Polyvinylchloride Conduit and Fittings for Underground Installation

Reference	Title
FEDSPEC WW-C-581E	Conduit, Metal, Rigid and Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated
FEDSPEC W-C-1094A	Conduit and Conduit Fittings, Plastic, Rigid
NEMA ICS 6	Industrial Control and Systems Enclosures
NEMA TC2	Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
NEMA TC6	PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NFPA 70	National Electrical Code (NEC)
NFPA 79	Electrical Standards for Industrial Machinery
UL 6	Rigid Metal Electrical Conduit
UL 360	Liquid Tight Flexible Electrical Conduit
UL 651	Rigid Nonmetal Electrical Conduit

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained

in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.
4. Supports, seismic bracing, and other electrical system mounting elements are generally not shown on the plan drawings. Hangers, supports, seismic restraints, and other electrical system mounting elements shall be submitted.

PART 2 PRODUCTS

2.1 RACEWAY SUPPORTS

A. CONDUIT SUPPORTS

1. Framing channel with end caps and straps shall be provided to support groups of conduit. Individual conduit supports shall be one-hole pipe straps used with clamp backs and nesting backs where required. Material as specified herein.
 2. Conduit supports for PVC coated rigid steel and PVC conduit systems shall be stainless steel strut (kindorf or Unistrut) with stainless steel pipe straps.
- B. MATERIALS: Table A specifies the type of raceway supports required for each location and application.

Table A

Location	Framing Channel and Accessories	Threaded Rod, Hardware, & Fittings
Outdoor	316 Stainless Steel	316 Stainless Steel
Submerged	316 Stainless Steel	316 Stainless Steel
Headspace	316 Stainless Steel	316 Stainless Steel
Chemical Corrosive	316 Stainless Steel	316 Stainless Steel
Process Corrosive	316 Stainless Steel	316 Stainless Steel

2.2 EQUIPMENT SUPPORTS

- A. Equipment supports shall be installed where shown on the drawings and as required to support the panels and enclosures being installed.
- B. Equipment support materials shall adhere to Table A above unless specified otherwise on the drawings.
- C. Equipment supports shall be installed per details in the Construction Documents.

2.3 CABLE SUPPORTS

- A. Provide stainless steel strain relief cable support grips for high ball and pump cables.
 1. Float switch – Molex, Woodhead Max-loc 130097-034
 2. Pump Cables – Molex, Series 130094 (size as needed for pump cabling diameter)

2.4 ANCHOR BOLTS

- A. Anchor bolts shall be as specified in WSDOT Standard Specifications Division 9: Materials.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Hangers and supports shall be installed with spacing between support points in compliance with all applicable codes.
- B. The cut ends of support channels shall be smoothed and without burrs left from cutting.
- C. See drawings for cable support installation of high-ball float switch.

END OF SECTION

SECTION 26 05 33

RACEWAYS, BOXES, AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope
 2. Reference Standards
 3. Quality Assurance
 4. Submittals
 5. Products
 6. Installation
 7. Raceway Specification Sheets

1.2 SCOPE

- A. This section covers the furnishing and installation of electrical conduits, wireways, pull boxes, electrical vaults, hand holes, and fittings. Raceways shall be provided for lighting, receptacles, power, control, instrumentation, signaling and grounding systems.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI C80.1	Rigid Steel Conduit-Zinc Coated
ANSI C80.3	Electrical Metallic Tubing-Zinc Coated
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FEDSPEC WW-C-581E	Conduit, Metal, Rigid and Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated
FEDSPEC W-C-1094A	Conduit and Conduit Fittings, Plastic, Rigid
NEMA ICS 6	Industrial Control and Systems Enclosures
NEMA TC2	Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
NEMA TC6	PVC and ABS Plastic Utilities Duct for Underground Installation

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or material.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

1.6 HANDLING AND STORAGE:

- A. In accordance with the WSDOT Standard Specification Section 1-06.4.

PART 2 PRODUCTS

2.1 RACEWAY

- A. General requirements for raceway materials specified in this section are listed in the RACESPECS sheets at the end of this section. The type of raceway to be used for any given area and application shall conform to the requirements of Table A in this section.
- B. Unused conduits shall be provided with conduit seal caps.
- C. All conduits other than the underground service conduit and equipment needing flexible connections shall be PGRS (PVC coated galvanized rigid steel).

2.2 BOXES AND FITTINGS

- A. Provide Meyers hub fittings for all conduit penetrations into enclosures.
- B. Provide unions where shown on the drawings for ease of separating conduit segments.

- C. PULL BOXES: Provide NEMA 4X fiberglass or polycarbonate junction boxes for routing of conductors interior to valve vault.

2.3 RACEWAY SUPPORTS

- A. All support systems for electrical systems shall be as specified in Section 26 05 29.

2.4 UNDERGROUND MARKING TAPE

- A. Underground marking tape shall be for early warning protection of digging around buried conduits and shall be provided and installed as specified in City of Lacey Section D: Special Provisions Section 7-08.3(8).

2.5 NAMEPLATES

- A. Nameplates shall be provided for all pull and junction boxes in accordance with the requirements of Section 26 05 00. Nameplate numbering shall be as indicated on the drawings. Where no wording is specified, the Contractor shall provide the functional description of the device on the nameplate or as required by the Engineer and Owner. Any nameplates provided where the wording is not specified shall first be approved by the Engineer and Owner.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Table A specifies the type of raceway required for each location and application. Unscheduled conduit, (i.e. lighting, convenience outlets, etc.), not shown on the drawings shall be in accordance with Table A below.

Table A

Location	Application/Condition	RACESPEC
Outdoor	Exposed	PGRS
Concealed	Power circuits embedded in concrete structure or beneath slab-on-grade	PGRS
Concealed	Instrumentation, communications and data signals encased in concrete, duct bank	PGRS
Underground	Power circuits encased in concrete, duct bank	PGRS
Underground	Power circuits directly buried	PGRS
Underground	Instrumentation, communications and data signals directly buried	PGRS
Underground	Utility service	PVC4

Nonhazardous	Final connection to equipment	LFS
Hazardous corrosive	Exposed	PGRS
Hazardous corrosive	Final connection to instrumentation	LFS

3.2 CONDUIT

A. GENERAL:

1. The number of directional changes of a conduit shall be limited to 360 degrees in any run between pull boxes.
2. Conduit runs shall be limited to a maximum of 400 feet, less 100 feet or fraction thereof, for every 90 degrees of change in direction.
3. Provide pull and junction boxes per code. When shown on drawings, box or manhole sizes shall be considered to be minimum sizes and shall be upsized by the Contractor for ease of pulling wire or if required by NEC.
4. Conduits that are intrinsically safe and entering the Main Control Cabinet shall enter the cabinet in the designated (red lined taped) floor area and should be no closer than 2" to the red lined area.

B. INDOOR AND OUTDOOR CONDUIT SYSTEMS:

1. In general, Contractor shall be responsible for determining conduit routing that conforms to the specified installation requirements as shown on the drawings.
2. Conduit installation shall conform to the requirements of the RACESPEC sheets and the following specified installation requirements:
 - a. Exposed conduit: Install parallel or perpendicular to structural members and surfaces. Install conduit horizontally and allow minimum headroom of 7 feet.
 - b. Route two or more exposed conduits in the same general routing parallel with symmetrical bends.
 - c. Maintain minimum spacing between exposed parallel conduit and piping runs in accordance with the following when the runs are greater than 30 feet:
 - 1) Between instrumentation and telecommunication: 1 inch
 - 2) Between instrumentation and 125 VDC, 48 VDC, and 24 VDC: 2 inches
 - 3) Between instrumentation and 600 VAC and less power: 6 inches
 - 4) Between instrumentation and 600 VAC and greater power: 12 inches

- 5) Between telecommunication and 125 VDC, 48 VDC, and 24 VDC: 2 inches
 - 6) Between telecommunication and 600 VAC and less power: 6 inches
 - 7) Between telecommunication and 600 VAC and greater power: 12 inches
 - 8) Between 125 VDC, 48 VDC, and 24 VDC and 600 VAC and less power: 2 inches
 - 9) Between 125 VDC, 48 VDC, and 24 VDC and 600 VAC and greater power: 2 inches
 - 10) Between 600 VAC and less power and 600 VAC and greater power: 2 inches
 - 11) Between process, gas, air and water pipes: 6 inches
- d. Space exposed conduit installed on supports not more than 10 feet apart. Space multiple conduits in parallel and use framing channel.
 - e. Cap conduits or plug flush conduits during construction to prevent entrance of dirt, trash, and water. Cap or plug empty conduits designated as “future”, “spare”, or “empty” and include a pulling line accessible at both ends. Use anti-seize compound on cap and plug threads prior to installation.
 - f. Determine concealed conduit stub-up locations from the manufacturer’s shop drawings. Terminate concealed conduit for future use in specified equipment.
 - g. Install conduit flush with structural surfaces with galvanized couplings and plugs. Caps and plugs shall match the conduit system.
 - h. Provide concealed portions of conduits for future equipment where the drawings indicate future equipment. Match the existing installation for duplicate equipment.
 - i. Terminate conduits that enter enclosures with Myers hub fittings that match the NEMA rating of the enclosure.
 - j. Underground metallic or nonmetallic conduit that turn out of concrete, masonry or earth: Install a 90-degree elbow of PVC-coated rigid steel conduit before emergence above ground.
- C. UNDERGROUND CONDUIT SYSTEM: Excavation, backfilling, and concrete work shall conform to respective sections of these specifications. Underground conduit shall conform to the following requirements:

1. Underground conduits shall be reinforced concrete encased under roadways or where otherwise exposed to possible damage or where adequate cover does not exist.
2. Concrete encased conduit shall have minimum concrete thicknesses of 2 inches between conduits, 1 inch between conduit and reinforcing, and 3 inches between reinforcing and earth, unless shown otherwise in an electrical detail.
3. Concrete encasement on exposed outdoor conduit risers shall continue to 3 inches above grade, with top crowned and edges chamfered.
4. Underground conduit bend radius shall be not less than 1 feet minimum at vertical risers and shall be not less than NEC allowances elsewhere.
5. Where conduit and concrete encasement are terminated underground, the conduit and reinforcing shall both extend at least 2 feet past the concrete. Conduits shall be capped and threads protected. Steel surfaces shall be given two coats of epoxy paint.
6. Underground conduits and conduit banks shall have 2 feet minimum earth cover unless otherwise shown.
7. Underground conduit banks through building walls shall be cast-in-place or installed with concrete into boxouts with water stops on all sides of the boxout. Water-stops shall be as specified in the Cast-in-Place Concrete section. Extend the horizontal reinforcement from the duct bank into the boxout terminating with J-hook bends.
8. Conduits not encased in concrete and passing through walls with one side in contact with earth shall be sealed watertight with special rubber gasketed sleeve and joint assemblies or with sleeves and modular rubber sealing elements (Link-seal).
9. Thoroughly swab conduits and raceways on the inside, immediately upon completion of pouring concrete.
10. After the concrete has set and before backfilling, pull a mandrel through each conduit. The mandrel shall have a diameter equal to the nominal conduit inside diameter minus 1/2 inch and shall not be less than 4 inches long.
11. If the mandrel showed signs of protrusions on the inside of the conduit, the conduit shall be repaired or replaced.
12. Provide manufactured plastic conduit spacers anchored to prevent movement during the concrete pour. Manufacturer: Carlon, PW Pipe, Underground Devices, or equal.

13. Backfill duct banks with clean fill compacted to 90-percent in 6-inch lifts after concrete has cured. Concrete to have a minimum 7 days of cure time prior to backfill over duct banks.
 14. Provide PVC threaded adapter with female threads where PVC conduit is joined to steel conduit. Procedure:
 - a. Before assembly: Double coat steel conduit with Red-Robroy, Green-Permacote, Blue-Ocal or approved equal product.
 - b. After assembly: Seal with 65-mil thick, 2-inch-wide mastic sealing tape to 1/2-inch beyond threads. Products: 3M Scotch 2228; Plymouth 02625; or approved equal.
 - c. Cover with 20-mil corrosion protection tape applied in 1/2-lap layers to 2-inch beyond threads. Products: 3M Scotchwrap 51; Plymouth Plywrap 12; or approved equal.
 15. Separate power conduits from signal conduit within the same duct bank by 12" or greater separation where possible.
- D. CONDUIT SEAL-OFF FITTINGS:
1. Conduits passing:
 - a. Between Class I, Division 1 area and Class I, Division 2 area; provide sealing fittings located at the boundary in accordance with NEC Article- 500.
 - b. From hazardous or corrosive area into a non-hazardous or non-corrosive area.
 2. Separate conductors through seal-off fitting with Appleton F01 fiber filler and fill with Appleton AC1A sealing cement after final inspection.
- E. CONDUIT SEALING MATERIAL: Provide HYDRA-SEAL® Handi-Polyurethane-Foam or approved equal product to seal conduits and inner ducts.
1. Sealing product required features
 - a. Compatible with common cable jacket materials.
 - b. ASTM E-84 flame spread requirements and UL Classified.
 - c. Pre-pressurized, portable, one-component closed-cell foam sealing system.
 - d. Dries tack-free within 15 minutes and cures within 24 hours.
 - e. Reacts with applied moisture or with ambient humidity.
 - f. Remove over-spray with acetone and remove cured foam mechanically
 2. Application Criteria:

- a. Apply in ambient temperatures between 60° to 100° F.
- b. Apply bead onto clean surface.

3.3 RACEWAY NUMBERING

- A. Each conduit shall be provided with a number tag at each end and in each manhole, hand hole, or pull box.
- B. Within electrical vaults, glue raceway tag to manhole wall next to raceway penetration.

3.4 RACEWAY SCHEDULE

- A. GENERAL: Raceways are scheduled on the drawings.
- B. UNSCHEDULED RACEWAY:
 1. With the exception of instrumentation connection and receptacle circuits, the type and size of raceway shall be as specified on the drawings or schedules.
 2. Unscheduled raceways shall be sized by the Contractor in accordance with the NEC. Minimum size shall be 3/4 inch for exposed and 1 inch for embedded raceway. Raceways may be smaller for final connections to instrumentation and shall be per manufacturer's recommendations.

3.5 RACESPEC SHEETS

- A. The following RACESPECS are included in Paragraph 3.6.
 1. LFS
 2. PGRS
 3. PVC4

3.6 RACEWAY SPECIFICATION SHEETS (RACESPEC)

A. RACEWAY SPECIFICATION SHEETS (RACESPEC) - LFS

Raceway Identification	LFS
Description	Liquid-tight Flexible Steel Conduit.
Application	Final connection to equipment subject to vibration or adjustment.
Compliance	UL 360.
Construction	Spirally wound galvanized steel strip with successive convolutions securely interlocked and jacketed with liquid-tight plastic cover.
Minimum size	$\frac{3}{4}$ inch, except for instruments where $\frac{1}{2}$ inch is acceptable.
Fittings	Cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral O-ring seals around the conduit and box connection and insulated throat Provide forty-five and ninety degree fittings where applicable Provide PVC coated flexible conduit and fittings where the conduit system is PVC coated
Manufacturers	Anamet, Atkore, Electri-flex
Installation	Length of flexible liquid-tight conduit shall not exceed 36 inches in length. Use conductive thread compound.

B. RACEWAY SPECIFICATION SHEETS (RACESPEC) – PGRS

Raceway Identification	PGRS
Description	<p>Galvanized Rigid Steel Conduit, Corrosion-Resistant, Polyvinyl Chloride (PVC) Coated.</p> <p>Provide factory made and coated elbows.</p>
Compliance	ANSI and UL. The PVC coated rigid galvanized steel conduit shall meet NEMA RN1-2005 and UL-6 PVC adhesion performance requirements.
Finish	<p>PGRS shall be hot-dip galvanized rigid steel conduit with a PVC Coating. The PVC coating shall be gray, minimum 40 mils thick, bonded to the outside and continuous over the entire length of the conduit except at the threads, and be free of blisters, bubbles, or pinholes. Thread protectors shall be used on the exposed threads of the PVC coated conduit</p> <p>A 2-mil coat of urethane enamel coating shall be bonded to the inside. Coating shall be free of pinholes. Bond strength shall exceed the tensile strength of the PVC coat.</p>
Minimum size	¾ inch
Fittings	Similarly coated to the same thickness as the conduit and provided with Type 316 stainless steel hardware. Conduit and fittings shall be manufactured by the same company. Conduit and fittings shall be coated by the same company. Male threads on elbows and nipples, and female threads on fittings or conduit couplings shall be protected by application of urethane coating.
Covers	PVC coated covers shall have a NEMA 4X rating and stainless-steel hardware.
Conduit Bodies	40% Oversized conduit bodies with covers as specified above.
Hubs	<p>Hubs for connection of conduit to junction, device, or terminal boxes shall be threaded cast ferrous alloy.</p> <p>Hubs shall have the same PVC coating as the conduit and insulating grounding bushings. Hubs shall utilize a neoprene “O” ring and shall provide a watertight connection.</p>

Boxes

Nonhazardous Type FD cast ferrous with PVC coating for all device boxes and for junction boxes less than 6 inches square.

Hazardous NEMA Class 4X stainless steel or nonmetallic for junction boxes 6 inches square and larger.

Manufacturers Ocal Blue, Plasti-Bond, Perma-Cote.

Installation Plastic coated conduit shall be made up tight, threaded, and installed using tools approved by the PVC-coated conduit manufacturer.

Exposed conduit threads shall be covered by a plastic overlap coated and sealed per manufacturer's recommendations.

Pipe wrenches and channel locks shall not be used for tightening plastic-coated conduits. Damaged areas shall be patched, using manufacturer's recommended material. The area to be patched shall be built up to the full thickness of the coating. Painted fittings are not acceptable.

PVC coated conduit shall be supported away from the structure using PVC coated conduit wall hangers or PVC coated conduit mounting hardware.

Damaged work shall be replaced.

Training Installers shall be trained and certified in the proper installation techniques provided by the PVC-coated conduit system manufacture. Proof of certification shall be provided.

C. RACEWAY SPECIFICATION SHEETS (RACESPEC) – PVC4

Raceway Identification	PVC4
Description	Rigid Nonmetallic Conduit.
Application	Heavy wall thickness for direct bury, concrete encasement or surface mounting where not subject to physical damage.
Compliance	NEMA TC2, UL 651
Construction	Schedule 40, high-impact, polyvinylchloride (PVC).
Minimum size	$\frac{3}{4}$ inch exposed; 1 inch embedded or encased
Fittings	PVC solvent weld type.
Boxes	
Indoor	NEMA Class 4, nonmetallic
Outdoor and corrosive	NEMA Class 4X stainless steel or nonmetallic for junction boxes 6 inches square and larger.
Manufacturers	Atkore, Cantex, Prime
Installation	<p>PVC conduit entering fiberglass boxes or cabinets shall be secured by threaded bushings on the interior of the box and shall be terminated with a threaded male terminal adapter having a neoprene O ring.</p> <p>Joints shall be made with standard PVC couplings.</p> <p>PVC conduit shall have bell ends where terminated at walls and boxes.</p>

END OF SECTION

SECTION 26 05 73

POWER SYSTEM STUDIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Products
 - 6. Execution

1.2 SCOPE

- A. This section specifies the preparation of a Power System Study Report using ETAP software to match existing studies provided to the City for other lift stations. The report shall include arc flash analysis, short circuit and coordination studies for all voltage levels of the electrical power system. The “electrical power system” starts at and includes the utility feed. Refer to the single-line diagrams of this Contract for details of the electrical power system at the Site. Provide in the report an evaluation of the electrical power system and the model numbers and settings of the protective devices for the entire system. Arc flash analysis shall include the method and recommendation in determining proper Personal Protective Equipment (PPE) and proper labeling of equipment as specified in this section. Provide equipment arc flash warning labeling.
- B. Arc-flash hazard studies shall include all new and modified equipment in the power distribution system including but not limited to:
 - 1. Utility equipment.
 - 2. Generator.
 - 3. Transformers:
 - a. Including all dry-type transformers.
 - 4. Motors.
 - 5. Panelboards:
 - a. Including all 208, 240, and 480-volt systems.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE 141	Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
NFPA 70E	National Electrical Safety Code
IEEE 1015	Recommended Practice for applying Low Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
IEEE 902	Guide for Maintenance, Operation and Safety of Industrial and Commercial Power Systems
NFPA 70	National Electrical Code
IEEE 1584	IEEE Guide for Performing Arc-Flash Hazard Calculations

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work.
- B. QUALIFICATIONS:
 1. Prepared by the manufacturer of the electrical equipment or by an electrical testing service or an engineering company which is regularly engaged in power system studies.
 2. All calculations shall be prepared by or prepared under direct supervision of a Washington State registered Professional Electrical Engineer. See the General Conditions for insurance requirements.
- C. CERTIFICATION: Arc flash report to be stamped and signed by a Washington State registered Professional Electrical Engineer.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - 3. Qualifications of the entity conducting the short circuit and coordination study.
 - 4. Short Circuit Analysis and recommended breaker and relay setting selections in coordination with Section 26 08 00.
 - 5. Electronic copies of power study software models with associated electronic library files.
 - 6. Submit a draft report to the owner within 21 days after receiving all electrical distribution system submittal data and feeder lengths. Approval of submittals shall be contingent on the results of the Power System Study Report.
 - 7. SCOPE OF EQUIPMENT: Contractor shall provide a short circuit and protective device coordination study and arc flash analysis for phase and ground faults for the

entire electrical distribution system. The study and labeling shall conform to NFPA 70E and the National Electrical Code.

PART 2 PRODUCTS

2.1 POWER SYSTEM STUDY REPORT

- A. Prepare a Power System Study Report summarizing the short circuit and coordination study, arc flash analysis and conclusions or recommendations which may affect the integrity of the electric power distribution system. The model and report shall reflect the project naming convention.
- B. As a minimum, include the following in the report:
 - 1. Equipment manufacturer's information used to prepare the study.
 - 2. Assumptions made during the study.
 - 3. Short circuit calculations listing short circuit levels at each bus.
 - 4. Evaluation of the electrical power system and the model numbers and settings of the protective devices associated with the system.
 - 5. Time-current curves including the instrument transformer ratios, model numbers of the protective relays, and the relay settings associated with each breaker.
 - 6. Comparison of short circuit duties of each bus to the interrupting capacity of the equipment connected to that bus.
 - 7. Analyze the short circuit, protective device coordination, and arc flash calculations and highlight any equipment that is determined to be underrated or causes an abnormally high incident energy calculation. Propose approaches to reduce the energy levels.
 - 8. Summarize the arc flash study and conclusions or recommendations which may affect the integrity of the electric power distribution system.
 - 9. ONE-LINE DIAGRAMS:
 - a. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.
 - b. Type designation, current rating, range or adjustment manufacturer's style and catalog transformers.

- c. Power, voltage ratings, impedance, primary and secondary connections of all transformers.
- d. Nameplate ratings of all motors and generator with their subtransient reactances.
- e. Transient reactances of generator and synchronous reactances of generator.
- f. Sources of short circuit elements such as utility ties, generators, and induction motors.
- g. All significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc.
- h. Standby as well as normal switching conditions.
- i. Calculated 3-phase and single-line-ground fault currents at each bus.
- j. Calculated X/R ratio at each bus.
- k. Calculated incident energy level at each bus.
- l. Hazard Risk Category at each bus.

2.2 SHORT CIRCUIT STUDY

A. As a minimum, include the following:

1. CALCULATIONS:

- a. Determine the paths and situations where short circuit currents are the greatest. Assume bolted faults and calculate the 3-phase and line-to-ground short circuits of each case.
- b. Calculate the maximum and minimum ground-fault currents.
- c. Model Variable Frequency Drives and Solid-State-Soft Starters and include bypass switches.
- d. Where the calculated available fault current is higher than the device ratings determine if a Series-rated system exists. Where series-rated systems have been identified provide labeling per NEC Article 110.22.
- e. Provide labeling at each service and separately derived system indicating calculated available fault current per NEC Article 110.24.

- f. A copy of the ETAP “Device Evaluation Comprehensive Branch Report”. Generate report after an “Equipment Evaluation” analysis has performed using the following settings:
 - 1) Study Result: Balanced
 - 2) Device Type: Protective Devices
 - 3) Fault Type: Bus
 - 4) Fault Study: Comprehensive

2.3 COORDINATION STUDY

- A. As a minimum, include a 17”x11” drawing which includes protective device coordination analysis (TCC) and associated single line. The TCC shall be shown on a 5-cycle, log-log graph background and include:
 - 1. Time-current curve for each circuit breaker, protective relay, or fuse showing graphically that the settings will allow protection and selectively within Industry standards. Identify each curve and specify the tap and time dial setting. Any circuit protective device that has programmable characteristics shall be included in the coordination study.
 - 2. Time-current curves for each device to be positioned for maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, notify the Engineer and Owner as to the cause.
 - 3. Time-current curves and points for cable and equipment damage.
 - 4. Circuit interrupting device operating and interrupting times.
 - 5. Indicate maximum fault values on the graph.

2.4 ARC FLASH ANALYSIS

- A. As a minimum, include the following:
 - 1. CALCULATIONS:
 - a. For each major part of the electrical power system, determine the following:
 - 1) Flash hazard protection boundary.
 - 2) Limited approach boundary.
 - 3) Restricted approach boundary.
 - 4) Prohibited approach boundary.
 - 5) Incident energy level.
 - 6) PPE hazard/risk category.
 - 7) Type of PPE required.

- b. Produce arc flash warning labels using the ETAP model template.
- c. A copy of the ETAP “Arc Flash_IEEE 1584 Report”. Generate report after an “Arc Flash Evaluation” analysis has performed using the following settings:
 - 1) Standard: IEEE 1584
 - 2) Flash Boundary Calculation Adjustments: Use 1.2 cal/cm²
 - 3) ≤ 240 V: Report Calculated Values from Equations
 - 4) Units: English
 - 5) Distance and Boundary: in

PART 3 EXECUTION

3.1 GENERAL

- A. Perform the studies using actual equipment data from the equipment and devices that are provided by the Contractor and the data from the actually installed existing equipment or protective relay devices. The Contractor is responsible to gather all field information for the short circuit and coordination studies. Where the report or study is conducted on equipment that is not installed, the short circuit report and the coordination study shall be completely redone at the Contractor’s expense.

3.2 IMPLEMENTING PDCS SETTINGS AND ARC FLASH SIGN INSTALLATION

- A. The Contractor shall implement the protective device coordination study settings on new and existing equipment as required in Section 26 08 00, based on the accepted Protective Device Coordination Report specified herein and submit a final amended report of the Record As-Built electrical equipment protective device settings subsequent to start-up and testing.
- B. The Contractor shall work with the Study Firm for implementing the Arc Flash Hazard sign installation requirements for electrical equipment as specified in NEC Article 110.16 Flash Protection and NFPA 70E.

END OF SECTION

SECTION 26 05 85

UTILITY COORDINATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes requirements for:
 - 1. Coordination with the Utility companies to provide service.
 - 2. Contractor's responsibilities for connecting to utilities and providing utility service to the facilities.
 - 3. Descriptions of utility services required.
- B. The Contractor shall coordinate with the local electric Utility for the installation of the primary electrical service.
 - 1. Electric Utility:
 - a. Utility: Puget Sound Energy (PSE)
 - b. Phone number: 1-360-522-3156
 - c. Contact: John Singleton
 - 2. Contractor shall coordinate with Puget Sound Energy or other local electric utility prior to installing underground conduit. See Drawings for the separation point between the local electric utility and the Contractor.
 - 3. Temporary power is not currently available to the project site. Contractor shall coordinate and provide temporary power at the project site when required and necessary.
 - 4. Testing and start-up power shall be connected on the secondary side of the existing service disconnect. Contractor to install new handhole and route new conductors and conduit to new station for temporary testing and start-up power before salvaging/demoing existing equipment. After testing, contractor to cut-over and splice existing power feed from transformer via new handhole, conduit and conductors used for new station testing, creating the final station service connection.
 - 5. Coordinate all cut-over and disconnect/reconnect of service with PSE.

1.2 REFERENCES

- A. Refer to Section 26 05 00.

1.3 DEFINITIONS

- A. Refer to Section 26 05 00.

1.4 SYSTEM DESCRIPTION

- A. Electrical Service:

1. Provide electrical ducts, raceways, conductors, and connections indicated on the Drawings. Work and materials required for a complete electrical service shall include but not be limited to the following:
 - a. Electrical service conduits and conductors from the point of Electric Utility connection to the service entrance equipment.
 - b. Meterbase per utility requirements.
 - c. Excavation and backfill per utility requirements for primary and secondary conduits and transformer.
 - d. Conduits and conductors from new utility transformer to the meterbase.

- B. General:

1. Coordinate and obtain inspections and final installation approval from serving utilities and other authorities having jurisdiction.

- C. Cutover of Existing Service:

1. Coordinate and verify cutover requirements of existing service conduit, conductors with the utility.
2. Coordinate all shutdown and disconnection.

1.5 SUBMITTALS

- A. Furnish submittals in accordance with Section 26 05 00 and to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.

- B. Certification:

1. Submit certification that the intended installation has been coordinated with the Utility companies.

2. Certification shall include a narrative description of the Utility's requirements and points of connection and names and telephone numbers for contacts at the Utilities.

1.6 QUALITY ASSURANCE

- A. Refer to Section 26 05 00.
- B. Materials and equipment used in performance of electrical work shall be listed or labeled by Underwriter's Laboratories or other equivalent recognized independent testing laboratory.

1.7 PROJECT OR SITE CONDITIONS

- A. Refer to Section 26 05 00.

1.8 SCHEDULING

- A. General:
 1. Before start of site work, make arrangements for temporary electrical service as required.
- B. Electrical systems:
 1. The Electrical Contractor shall contact the Utilities to determine the work and materials to be provided by the Contractor, and all fees and permits that will be required.
 - a. The owner will pay any required utility improvement fees directly.
 2. Before commencing work, coordinate electric service entrance requirements with the local Electric Utility to assure that the installation is completed in accordance with these Specifications and all local utility requirements:
 - a. Ensure electrical characteristics and location are consistent with the design.
 - b. Arrange for installation of utility meter.
 3. Coordinate with the Electric Utility for connection and turn-on.
- C. Before commencing site work, coordinate underground conduit installations with other work to eliminate conflicts and avoid interferences with other underground systems.

1.9 WARRANTY

- A. Refer to Section 26 05 00.

1.10 COMMISSIONING OF ELECTRICAL SYSTEMS

- A. Refer to Section 26 08 00.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Furnish materials in accordance with the applicable requirements of the utilities and these Specifications.

2.2 EQUIPMENT

- A. Furnish equipment in accordance with the applicable requirements of the Utilities and these Specifications.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation of service equipment to be in coordination with utility requirements, and the latest information provided in the Puget Sound Energy Electrical Service Handbook.
- B. Refer to Section 26 05 00.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Products
 - 6. Testing
 - 7. Functional Checkout

1.2 SCOPE

- A. This section specifies the acceptance testing of electrical materials, equipment, and systems. Provide all labor, tools, material, power, and other services necessary to provide the specified tests.
- B. All testing required herein and the test results shall also be submitted and documented as required under Section 26 05 00, and where identified within the specific sections.
- C. Test results for a specific piece of equipment shall also be included in the operation and maintenance manual(s).

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
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ANSI/NETA ATS- 2021	Standard for Acceptance Testing Specifications for Electrical Power Distribution Equipment Systems
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- C. APPLICATION: Where testing in accordance with this section and other Division 26 Sections is required or recommended by the above standards are to be completed prior to energization, the required tests, including the retesting after the correction of found defects must be complete, and the submittal of final test reports to the Owner for review shall be completed prior to the energizing of material, equipment, or systems.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work.
- B. Comply with section 5, General, of the ANSI/NETA ATS – 2021 standard for safety, test equipment requirements.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Proposed testing procedures including proposed test report forms.
 - 2. Test reports including documentation for all tests performed. Test reports shall be submitted for review prior to the equipment being energized.
 - 3. Execution plan including schedule.

PART 2 PRODUCTS

2.1 TESTING EQUIPMENT AND INSTRUMENTS

- A. The test equipment, instruments and devices used for testing shall be calibrated to test equipment standards with references traceable to the National Institute of Standards and Technology. The test equipment, instruments and devices shall have current calibration stickers indicating date of calibration, deviation from standard, name of calibration laboratory and technician, and date of next recalibration.

2.2 PRODUCT DATA

- A. The following information shall be provided and shall comply with requirements of the City of Lacey Section D: Special Provisions.

1. Test reports: Provide the report required in NETA ATS-2021 paragraph 5.4. Results shall be placed on the forms specified in this Section. Test reports shall also be part of the operation and maintenance manuals.
 - a. The test report shall include the following:
 - 1) Summary of project.
 - 2) Description of equipment tested.
 - 3) Description of tests.
 - 4) Device settings.
 - 5) Test data.
 - b. Test data records shall include the following
 - 1) Equipment Identification.
 - 2) Nameplate data.
 - 3) Date of testing.
 - 4) Expected test value/result.
 - 5) Actual test result.
 - 6) Testing results outside of acceptable limits.
2. Short circuit analysis and protective device curves.
3. Defects: Notify the Owner of any material or workmanship found defective within 24 hours of discovery.

EXECUTION

2.3 TESTING

A. GENERAL

1. Ensure that all testing performed is in strict conformance with the electrical acceptance tests specified herein. Contact the Owner 10 days prior to the testing to allow witnessing of all tests.
2. The test measurements shall be recorded on specific forms for the subject test.
3. Testing shall be per ANSI/NETA ATS 2021. Provide testing data sheet for the following:
 - a. Cables – Low voltage (600 VAC maximum)
 - 1) Testing for cabling shall also comply with WSDOT Standard Specifications section 8-20.3(11)
 - b. AC Induction Motors
 - 1) Testing for pump motor shall also comply with the City's Lift Station Pump Pre-Startup Check List for electrical checks.
 - c. Transformers – Small Dry-type, air cooled (600 VAC and below, 30 kVA and larger)
 - d. Circuit breakers – Low voltage (Insulated Case/Molded Case)
 - e. Grounding Systems
 - f. Motor Starter
 - g. Outdoor Generator Systems
 - h. Uninterruptable Power Systems
 - i. Automatic Transfer Switches

B. FUNCTIONAL CHECKOUT:

1. Comply with all requirements of 26 05 00.
2. Functional testing shall be performed in accordance with the requirements of this Section. Prior to functional testing, all protective devices shall be adjusted and made operative. Prior to energizing the equipment, perform a functional checkout

of the control circuits. Checkout shall consist of energizing each control circuit and operating each control, alarm or malfunction device and each interlock in turn to verify that the specified action occurs. Submit a description of proposed functional test procedures prior to the performance of functional checkout.

3. Verify that motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor after confirming that neither the motor nor the driven equipment will be damaged by reverse operation.
4. Verify all overloads are set for motors provided and operate accordingly.
5. Verify switchover for operation on Generator and re-transfer.
6. Verify function of all lighting, including exterior area lighting and lighting within the Main Control Panel.
7. Verify starting and stopping of motors using Hand/Off/Auto switches on pump control panel.
8. Verify lock-out operation of pumps due to pump motor thermal relay trip, and resetting of relay.
9. Reference section 48 61 13 for Process control testing and commissioning.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Scope
2. Reference Standards
3. Quality Assurance
4. Submittals
5. Products
6. Execution

1.2 SCOPE

- A. This Section specifies general use wiring devices consisting of receptacles, plugs, switches and appurtenances. Also covered in this section are plugs and receptacles used for motor disconnecting or isolation means.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

1. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NEMA WD-1	General Requirements for Wiring Devices
NEMA WD-6	Wiring Devices - Dimensional
NFPA 70	National Electrical Code (NEC)
UL 20	General-Use Snap Switches
UL 498	Attachment Plugs and Receptacles
UL 514A	Metallic Outlet Boxes
UL 894	Switches for Use In Hazardous (Classified) Locations
UL 943	Ground-Fault Circuit Interrupters

Reference	Title
UL 1010	Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.

- a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
- b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
- c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

PART 2 PRODUCTS

2.1 GENERAL

- A. Wiring devices shall be UL approved for the current and voltage specified and shall comply with NEMA WD-1. Devices shall contain provisions for back wiring and side wiring with captive binding screws.
- B. Provide devices colored to conform to manufacturer's or industry standard for special use such as orange for isolated ground receptacles, blue for surge suppression receptacles, and red for emergency power receptacles. Unless shown otherwise on the Drawings or Schedules, normal use devices shall be gray, except those located in finished areas shall be ivory.

2.2 RECEPTACLES AND PLUGS

- A. GENERAL: Receptacles shall be grounding type.
- B. 120V RECEPTACLES:
 - 1. OUTDOOR, PROCESS OR CORROSIVE AREAS: Receptacle shall be duplex, 20 ampere, NEMA 5-20R, IP65/66/67, and shall accept NEMA 5-15P and 5-20P plugs. Receptacle and plug shall be weather resistant, watertight, with polycarbonate weatherproof in-use cover.
 - a. Manufacturers: Hubbell 5362GYWR/ RW58300, or approved equal.
 - 2. INDOOR/OUTDOOR, GROUND FAULT CURRENT INTERRUPTING: receptacle shall be a complete unit with a din-rail mounted utility box with duplex, 15 ampere, NEMA 5-15R GFI and shall accept NEMA 5-15P plugs.
 - a. Manufacturers: Hubbel DRUBGFI15 DGK.

- C. THREE PHASE RECEPTACLES AND PLUGS: Receptacles shall be suitable for 208 volt, 3-phase, 3-wire service, with ampere ratings as specified. Receptacles and plugs shall be designed so that the grounding pole is permanently connected to the housing. The grounding pole shall make contact before the line poles are engaged when the plug is connected to the receptacle housing. The plug sleeve shall also make contact with the receptacle housing before the line and load poles make contact. Receptacles shall be provided complete with accessory handle, gaskets, and a gasketed screw-type, weather tight cap with chain fastener. Each receptacle shall be provided with one plug.
1. Plugs and receptacles used for motor disconnecting and isolating means must be approved for such use.
 - a. Non Metallic IP66/67 and NEMA 4X rated. Poly
 - b. Disconnect rated.
 - c. Provide units with current and HP ratings as required.
 - d. Receptacles to include dead front shutter that deploys automatically when receptacle is removed.
 - e. Plugs to be provided with spring assisted latching mechanism to secure in place when plugged into matching receptacle.
 - 1) Latching mechanism to include quick release button.
 - f. Provide with two auxiliary / pilot contacts rated for 1.5 amps at 208 VAC.
 - 1) Where shown on the drawings or required by specific equipment, provide additional pilot contacts as required and as available within the product line.
 2. Manufacturers: Meltric "DSN" series (See drawings for specific models).

2.3 SWITCHES

- A. GENERAL PURPOSE (INDOOR, OCCUPIED AREAS): General purpose switches shall be rocker type, quiet AC type, specification grade, back and side wired, and shall be provided in accordance with rated capacities as required or as indicated on Drawings. Switches shall be white in color with stainless steel cover. Voltage and current ratings shall be 120VAC, 20-ampere.
1. Manufacturers: Bryant CSB120BW, SS1 cover and Cooper TP7010 bell box.

PART 3 EXECUTION

3.1 GENERAL

- A. Receptacles and switches to be provided and installed with vinyl labels as shown on the drawings.
- B. Test and reset GFCI's for operational acceptance.
- C. Verify switch operation with outdoor luminaire.

END OF SECTION

SECTION 26 28 16.13

ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Definitions
 - 5. Submittals
 - 6. Coordination
 - 7. Products
 - 8. Execution

1.2 SCOPE

- A. This section includes individually mounted enclosed switches and circuit breakers used for the following:
 - 1. Service disconnecting means.
 - 2. Feeder and branch-circuit protection.
 - 3. Motor and equipment disconnecting means.

1.3 REFERENCE STANDARDS

- A. NEMA AB 1 (National Electrical Manufacturers Association) - Molded Case Circuit Breakers.
- B. NEMA FU1 (National Electrical Manufacturers Association) - Low Voltage Cartridge Fuses.
- C. NEMA KS 1 (National Electrical Manufacturers Association) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- D. NETA ATS (National Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- E. NFPA 70 (National Fire Protection Association) - National Electrical Code.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment first start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 DEFINITIONS

- A. MCP: Motor Circuit Protector.
- B. RMS: Root mean square.
- C. SPDT: Single pole, double throw.

1.6 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.
4. Field Test Reports: Submit written test reports and include the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
5. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals and service manuals specified in City of Lacey Section D: Special Provisions Section 7-22.3(3)B. Include the following:
 - a. Routine maintenance requirements for components.
 - b. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
 - c. Time-current curves, including selectable ranges for each type of circuit breaker.
6. Shop Drawings: For each switch and circuit breaker.
 - a. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - 1) Enclosure types and details for types other than NEMA 250, Type 1.
 - 2) Current and voltage ratings.
 - 3) Short-circuit current rating.

- 4) Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- 5) Include time-current coordination curves for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 DELIVERY, STORAGE AND HANDLING

- A. In accordance with the WSDOT Standard Specification Section 1-06.4.
- B. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manual. One (1) copy of this document shall be provided with the equipment at the time of shipment.
- C. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. To ensure familiarity with operation, maintenance and spare parts with existing circuit breakers used by the City the circuit breakers shall be as manufactured by Eaton.

2.2 ENCLOSED CIRCUIT BREAKERS

- A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400A and smaller; let-through ratings less than NEMA FU 1, RK-5.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Appropriate for application; Type HMCP for motor circuits.
 3. Through-door, lockable handles with appropriate shaft length; red in color.
- C. Service Entrance: For enclosed circuit breakers identified for use as service equipment, provide solid neutral assembly and equipment ground bus.

2.3 ENCLOSURES

- A. NEMA AB 1, NEMA KS 1 and UL 50 to meet environmental conditions of installed location.
1. Outdoor Locations: NEMA 250, Type 4X, stainless steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 70 working space requirements and NECA 1.

- B. Standard Mounting Height: Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated. Operating handle typically at 5'-0" above grade or finished floor.
 - 1. Install breakers as shown on contract drawings, including but not limited to the service entrance breaker, motor circuit breakers, and transformer primary and/or secondary breakers as shown.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Provide neutral kit as required.
- E. Set adjustable parameters and provide testing and calibration as required by engineering considerations.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 53 - Electrical Identification.
- B. Install enclosure nameplate with switch or circuit breaker designation, power source, source location, voltage, load served and load location.
 - 1. Identify special conditions for shutting down load served.

3.4 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
 - 1. Mark lugs after torquing with red paint such that paint will be visibly disturbed if lugs are disturbed.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable switches and circuit-breaker trip ranges.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.7 OPERATION AND MAINTENANCE MANUALS

- A. Provide manufacturer's operation and maintenance information as specified in City of Lacey Section D: Special Provisions Section 7-22.3(3)B.

END OF SECTION

SECTION 26 29 13.13

ACROSS-THE-LINE MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Products.
 - 6. Installation
 - 7. Testing

1.2 SCOPE

- A. The Contractor shall furnish and install across-the-line motor controllers (magnetic starters) with amperage, voltage, and options for the pump sizes as required and as shown on the drawings.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE C62.41	(Institute of Electrical and Electronics Engineers) - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
UL 489	Molded Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
NEMA ICS 2	(National Electrical Manufacturers Association) - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 3	(National Electrical Manufacturers Association) - Industrial Control and Systems: Factory Built Assemblies
NEMA ICS 5	(National Electrical Manufacturers Association) - Industrial Control and Systems: Control Circuit and Pilot Devices
NETA ATS	(National Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
NFPA 70	(National Fire Protection Association) - National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for electrical work.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from the date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall

list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
- a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.
4. Installation instructions, outline dimensions and weights, front view drawing identifying control and monitoring devices, nameplate engravings, shipping dimensions, weight, and mounting requirements.
5. Assembly ratings including:
- a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 - d. Motor overload protection
 - e. Horsepower rating
6. Cable terminal sizes

7. Product data sheets, external connection diagram showing function and identification of all terminals requiring field connections.
8. Manufacturer's operation and maintenance information as specified in City of Lacey Section D: Special Provisions Section 7-22.3(3)B.
 - a. Manufacturer's written instructions for testing and adjusting overcurrent protective settings.
9. Schematics and wiring diagrams.

1.6 DELIVERY, STORAGE AND HANDLING

- A. In accordance with the WSDOT Standard Specification Section 1-06.4.
- B. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manual. One (1) copy of this document shall be provided with the equipment at the time of shipment.
- C. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 CANDIDATE MANUFACTURES/PRODUCTS

- A. To ensure familiarity with operation, maintenance and spare parts with existing magnetic starters used by the City the starters shall be a Freedom Series NEMA unit with a C440 electronic overload as manufactured by Eaton.

2.2 ACROSS-THE-LINE MOTOR CONTROLLERS

- A. General Requirements for Reduced-Voltage Solid-State Controllers: Comply with NEMA ICS 2, general purpose, Class A.
- B. Full voltage, across the line, electrically held starter and overload relay; suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.
 1. Configuration: Non reversing or reversing as shown on the drawings.
 2. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
 - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

3. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
 4. Control Circuits: 120VAC minimum rating for all axillary contacts.
 5. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor running thermal overload protection. Software selectable is not acceptable.
 - b. Phase loss detection.
 - c. Sensors in each phase.
 - d. Motor running/trip indicator.
 - e. Test/Trip button.
 - f. Class 10 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - g. Class II ground-fault protection.
 - h. Remote reset module, voltage as shown on the drawings.
- C. Across-the-line motor controller, OCPD, and disconnecting means.
1. MCP Disconnecting Means:
 - a. Use where shown on the drawings.
 - b. UL 489, UL 489, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable up to 1300% of motor FLA, short-circuit trip coordinated with motor locked-rotor amperes.
 - c. Lockable Handle: Accepts 3/8-inch hasp padlocks and interlocks with cover in closed position.

PART 3 EXECUTION

3.1 1 INSTALLATION

- A. Mount unit in Main Control Cabinet as shown in the drawings. Provide all overcurrent devices with handles and shafts as shown on the drawings.

- B. REQUIREMENTS: Section 26 05 00 and Install in accordance with manufacturer's instructions for the specified functional requirements.
- C. Torque all lugs per manufacturer's written recommendations.
- D. Verify proper rating and setting of overcurrent protective device.
- E. Verify correct conductor color-coding.
- F. Adjusting:
 - 1. Set motor circuit protectors as low as possible without causing nuisance tripping.
 - 2. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify the Engineer before increasing settings. If initial setting of six times the motor nameplate FLA rating does not cause tripping, adjust settings down so that setting is as low as possible without causing nuisance tripping.
 - 3. Set motor overloads per manufacturer's tables for actual motor nameplate full-load amperes.
 - 4. Set field-adjustable switches for trip settings.

3.2 TESTING

- 1. Comply with all requirements of 26 05 00.
- 2. Functional testing shall be performed in accordance with the requirements of this Section. Prior to functional testing, all protective devices shall be adjusted and made operative. Prior to energizing the equipment, perform a functional checkout of the control circuits. Checkout shall consist of energizing each control circuit and operating each control, alarm or malfunction device and each interlock in turn to verify that the specified action occurs. Submit a description of proposed functional test procedures prior to the performance of functional checkout.
- 3. Verify that motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor after confirming that neither the motor nor the driven equipment will be damaged by reverse operation.

4. Verify all setting of the electronic overload are set for motors provided and operate accordingly.
5. Reference the City's Lift Station Control Package including the Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. System Requirements
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Products
 - 6. Installation
 - 7. Testing

1.2 SCOPE

- A. The Contractor shall furnish and install Automatic Transfer Switch (ATS) with number of poles, amperage, voltage, and withstand current ratings as shown on the drawings. Each automation transfer shall consist of a contactor style switch mechanism and a microprocessor controller, interconnected to provide complete automatic operation.

1.3 SYSTEM REQUIREMENTS

- A. The ATS shall be Rated for use at 208 VAC, Amperage as indicated on the drawings and with a minimum withstand rating of 35,000 AIC unless otherwise shown on the drawings. Unit shall be 3-pole with a solid neutral unless shown or specified differently on the drawing. Unit shall be Open Transition style.

1.4 QUALITY ASSURANCE

- A. REFERENCE STANDARDS
 - 1. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
 - 2. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that

organization or, if there are no replacement documents, the last version of the document before it was discontinued.

- a. UL 1008 - Standard for Automatic Transfer Switches
- b. CSA 22.2 No 178
- c. IEC 60947-6-1
- d. NFPA 70 - National Electrical Code
- e. NEMA Standard ICS10-2005 (formerly ICS2-447) - AC Automatic Transfer Switches
- f. NEC Articles 700, 701, 702
- g. NFPA 110 - Emergency and Standby Power Systems
- h. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
- i. International Standards Organization ISO 9001: 2008

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
- b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.
4. Installation instructions, outline dimensions and weights, front view drawing identifying control and monitoring devices, nameplate engravings, shipping dimensions, weight, and wall mounting requirements.
5. Certification from the project generator supplier that the ATS provides all the features and functions required to monitor and control their generator adequately.
6. Component list
7. Conduit entry/exit locations where applicable
8. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
9. Cable terminal sizes
10. Product data sheets, external connection diagram showing function and identification of all terminals requiring field connections.

11. Manufacturer's operation and maintenance information as specified in City of Lacey Section D: Special Provisions Section 7-22.3(3)B.
12. Schematics and wiring diagrams.
13. Recommended spare parts list.
14. Factory test documentation.
15. In accordance with seismic anchoring requirements:
 - a. Certification of compliance with local code and seismic designation.
 - b. A sketch or description of the anchorage and restraint system.

1.6 DELIVERY, STORAGE AND HANDLING

- A. In accordance with the WSDOT Standard Specification Section 1-06.4.
- B. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manual. One (1) copy of this document shall be provided with the equipment at the time of shipment.
- C. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 CANDIDATE MANUFACTURES/PRODUCTS

- A. To ensure familiarity with operation and maintenance with existing transfer switches used by the City the automatic transfer switch shall be an ASCO D03ATSA30150NGXC-11BE.

2.2 AUTOMATIC TRANSFER SWITCH

- A. Furnish and install where indicated a "open transition" style, 3-pole (with solid neutral) as shown on the drawings, automatic transfer switch with ratings, features, accessories, enclosures, etc. indicated on the drawings or noted herein
- B. The transfer switch equipment as specified herein shall be 100% equipment rated for continuous duty at the ratings shown on the plans and shall conform to the applicable requirements for UL 1008 for emergency total system load. All transfer switch equipment supplied shall bear the UL label.

- C. All main power contacts shall be rated for multiple fault interruptions per UL 489, and/or UL 1087. Main contacts shall have independent “break-before-make” transfer action which shall positively prevent dangerous “source-to-source” connections.
- D. Automatic transfer switches specified herein shall consist of completely enclosed contact assemblies and a separately mounted control logic panel. Control power for all automatic transfer operations shall be derived from the line side of the source to which the load is being transferred.
- E. Upon loss of phase-to-phase voltage of the normal power source on any phase to 70% of nominal, and after a time delay of 0-6 seconds (adjustable to meet conditions present) to override momentary dips and/or outages, starting of the emergency/standby power source shall be initiated. Transfer to the emergency standby power source shall take place 2-120 seconds (adjustable) after attainment of 90% of rated voltage and frequency of that source.
- F. When the normal power source has been restored to 90% of rated voltage and after a time delay adjustable from 0-60 minutes 59 seconds (to ensure the integrity of the normal power source), the load shall be retransferred to the normal source and the delayed transfer as mentioned below.
- G. A time delay, adjustable 0-60 minutes 59 seconds, shall delay shutdown of the emergency/standby power source after retransfer to allow the generator to run unloaded for cool-down, after which the generator shall be automatically shut down.
- H. If the emergency/standby power source should fail while carrying the load, transfer to the normal power source shall be made instantaneously upon restoration of the normal source to satisfactory conditions.
- I. A graphical LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. In addition to operational parameters the following shall also be included via the LCD display and keypad:
 - 1. Auto/test switch to provide test operation of the automatic transfer switch by simulating a loss of the normal power source.
 - 2. Display to indicate to which source the load is connected.
 - 3. Display to indicate that an integral overcurrent protective device has tripped.
- J. The following features/accessories shall be provided:
 - 1. Plant exerciser timer providing automatic test operation of the emergency/standby power source at pre-selected intervals at least once per week, including a selector switch to select exercise with or without load or a bypass of the exercise period. The clock timer shall be provided with a digital readout and include a lithium

battery backup to assure continuity of power to the clock timer for a minimum of 72 hours during an outage.

2. Provide “dry”, form C contacts for the following conditions, as a minimum. Contacts shall be rated 10 Amps at 120 VAC:
 - a. ATS in “Normal” position
 - b. ATS in “Generator” position
 - c. ATS failure (common failure alarm)

PART 3 EXECUTION

3.1 1 INSTALLATION

- A. Mount unit in Main Control Cabinet as shown in the drawings.
- B. REQUIREMENTS: Section 26 05 00 and Install in accordance with manufacturer's instructions for the specified functional requirements.
- C. Automatic Transfer Switches shall be installed, configured and tested on site in accordance with the requirements of Section 26 05 00 and in accordance with the manufacturer’s recommendations. Field Setup shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- D. CONTRACTOR shall provide the services of the manufacturer’s representative for a minimum of one day for the calibration and testing of the equipment after certification of proper installation.

3.2 TESTING

- A. Coordinate with Generator supplier to provide an integrated test to demonstrate ATS senses loss of utility power, starts the generator, verifies the electrical output from the generator is valid and transfer the load to the standby power source.

Verify also that restoring Utility power is sensed appropriately by the ATS and that after the selected time delay, restores utility power to the generator. Verify proper generator cool down run time is provided for either in the generator or in ATS settings.

- B. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

- C. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
- D. Reference the City's Lift Station Control Package including the Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 26 56 13

LIGHTING POLES AND STANDARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Definitions.
 - 5. Structural Analysis Criteria for Pole Selection.
 - 6. Submittals.
 - 7. Product Requirements.
 - 8. Installation.

1.2 SCOPE

- A. This specification covers the furnishing and installation of poles and materials for exterior lighting. Products shall be as follows or as directed by the Owner. Installation procedures shall be in accordance with the product manufacturer's recommendations.
- B. Section Includes:
 - 1. Poles and accessories.

1.3 REFERENCE STANDARDS

- A. AASHTO LTS-4-M American Association of State Highway and Transportation Officials
- B. ASTM B 660 American Society for Testing and Materials
- C. NFPA 70 National Electrical Code
- D. NFPA 70E National Electrical Safety Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. Special Warranty for Poles and Pole Hardware: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may

exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
2. Warranty Period for Color Retention: Five years from date of Substantial Completion.
3. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

1.5 DEFINITIONS

- A. Luminaire: Complete lighting fixture, including ballast housing if provided.
- B. Pole: Luminaire support structure, including tower used for large area illumination.
- C. Standard: Same definition as "Pole" above.

1.6 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-5-M.
- B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-5-M.
- C. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied as stated in AASHTO LTS-5-M Ice Load Map.
- D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-5-M.
 1. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 100 mph (45 m/s) OR 90 mph (40 m/s).
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 25 years.
 - c. Velocity Conversion Factors: 1.0.

1.7 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.
- C. Product Data: For each pole and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
1. Physical description of pole, including materials, dimensions, and mounting.
 2. Details of installation and construction.

3. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 4. Anchor bolts for poles.
 5. Manufactured pole foundations.
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
- E. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.
- F. Operation and Maintenance Data.
- G. Warranty: Sample of special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on aluminum poles until right before pole installation.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage,

vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4-M.
 1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated. Attach with luminaires mounting arm kit per Section 26 56 19.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
 1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
 3. Anchor-Bolt Template: Provided by manufacturer.
- D. Handhole: Reinforced 3"x5" curved cast aluminum frame with aluminum door and two stainless steel hex head screws with a grounding provision incorporating a 3/8" hole opposite the handhole.

- E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified and shown on the contract drawings.

2.2 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B221, Alloy 6063-T6 with access handhole in pole wall.
 - 1. Shape: Round tapered.
 - 2. Height: 16 feet
 - 3. Mounting Provisions: 4" Butt flange for bolted mounting on foundation.
- B. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
 - a. Color: Black power coat.

2.3 MANUFACTURERS

- A. To match existing poles used at other sites by the Owner, the 16' aluminum round tapered pole shall be an Hapco RTA16D6B4-BA.

PART 3 EXECUTION

3.1 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
 - 1. Hazardous locations: 3 feet.
 - 2. 480V exposed electrical equipment: 3.5 feet.
 - 3. 120V exposed electrical equipment: 3 feet.

- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified on the contract drawings.
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers unless otherwise indicated.
 - 4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Raise and set poles using web fabric slings (not chain or cable).

3.2 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top 3 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are shown on the contract drawings.

3.3 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Division 26 Section "Raceway, Boxes and Fittings". In concrete foundations, provide PVC Coated rigid conduit.

3.4 GROUNDING

- A. Ground metal poles and support structures:
 - 1. Install grounding conductor pigtail in the base for connecting luminaire to grounding system interior to handhole of pole.

END OF SECTION

SECTION 26 56 19

LED EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Abbreviations
 - 3. Reference Standards
 - 4. Quality Assurance
 - 5. Submittals
 - 6. Product Requirements
 - 7. Installation
 - 8. Testing

1.2 SCOPE

- A. The extent and location of "Exterior Lighting" Work is shown in the Contract Documents. This section includes exterior luminaires and accessories.

1.3 ABBREVIATIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. ANSI C79.1, C81.61 – American National Standards Institute
- C. NEMA LE 4 – National Electrical Manufacturer's Association
- D. NFPA 70 – National Electrical Code (NEC)

1.5 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work

- B. WARRANTY: The Special Warranty shall include as a minimum the following:
1. A written 1-year on-site replacement material, fixture finish and workmanship. On-site replacement includes transportation, removal, and installation of new products. Finish warranty must include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking or fading.
 2. A written 1-year replacement material warranty for defective or non-starting LED source assemblies.
 3. A written 1-year replacement material warranty on all power supply units (PSU).
 4. A written 1-year replacement warranty for luminaires producing inadequately maintained illuminance levels at the end of the warranty period, as prorated from levels expected at end of useful life.
 5. The warranty period shall begin on the date of Substantial Completion. The Contractor shall provide the Owner with appropriate signed warranty certificates. The Owner shall have received these certificates prior to final payment.
- C. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- D. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- E. Provide luminaires from a single manufacturer for each luminaire type.
- F. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.6 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the

Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.
 - d. Arrange in order of luminaire designation.
 - e. Include data on features, accessories, and finishes.
 - f. Include physical description and dimensions of luminaires.
 - g. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
4. Photometric data and adjustment factors based on laboratory tests.

- a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- C. Shop Drawings: For nonstandard or custom luminaires.
- 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- D. Product Schedule: For luminaires and lamps.
- E. Manufacturer's installation instructions.
- F. CLOSEOUT SUBMITTALS
- 1. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. To maintain existing luminaires compatible with other sites, the exterior pole mounted luminaire shall be an RDA Lighting FL5S-LED150A50-B-4K-T3-BLK-DIM. Provide with FL5S MOUNTING ARM BLK.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Luminaire Attachment: Comply with luminaire manufacturer's mounting requirements. Install to luminaire pole as shown on the contract drawings with manufacturers arm mounting kit.
- B. Luminaire Output Adjustment: Set lumen output adjustment to full at 150W.

3.2 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Inspect each installed unit for damage. Replace damaged units.
- B. Advance Notice: Give dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests and Observations: Verify normal operation of luminaires after installing and energizing circuits with normal power source, and as follows:
 - 1. Measure light intensities at night if specific illumination performance is indicated. Use photometers with calibration referenced to NIST standard SP-250 or other relevant NIST publication.
 - 2. Check intensity and uniformity of illumination.
- E. Prepare a written report of tests, inspections, observations and verifications indicating and interpreting results.
- F. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3.4 CLEANING AND ADJUSTING

- A. Clean units after installation. Use methods and materials recommended by manufacturer.
- B. Adjust mount for luminaire leveling as required.

END OF SECTION

SECTION 40 06 70

SCHEDULES OF INSTRUMENTATION FOR PROCESS SYSTEMS

INSTRUMENT	OPTIONS	Spec. Section
ULTRASONIC LEVEL TRANSDUCER	Sensor CLASS 1, DIV. 1 – Intrinsic Safe	40 72 13
WETWELL HIGH BALL LEVEL FLOAT	(1) Normally Open contact	40 72 76
VALVE VAULT MAGNETIC FLOWMETER	Ground rings, potting, empty pipe detection	40 71 13
DISCHARGE PRESSURE TRANSDUCER	316L SS, Silicon oil, male ½" NPT, Intrinsic Safe	40 73 26
CHECK VALVE LIMIT SWITCHES	(1) Normally Open (1) Normally Closed contact	40 71 77

END OF SECTION

SECTION 40 61 13

PROCESS CONTROL SYSTEM GENERAL PROVISIONS

PART 1 GENERAL

1.1 SUMMARY

- A. This section specifies general requirements which are applicable to providing instrumentation and controls for the process system
- B. The requirements of this section are applicable to all work to be completed by the Facility Integrator and as specified in all sections of 40 61 XX, 40 63 XX, 40 67 XX, 40 71 XX, 40 72 XX, 40 75 XX, and 40 78 XX. Where XX refers to any specification section beginning with the preceding section numbers.
- C. Electrical requirements applicable to this work are specified in Division 26.
- D. Section includes:
 - 1. Scope
 - 2. Definitions
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Products
 - 6. Installation
 - 7. Testing
 - 8. Manufacturers Services

1.2 SCOPE

- A. The work consists of a qualified Facility Integrator to provide the requirements on this specification section as well as those listed or referenced herein.
 - 1. New primary process measurement devices, instrumentation and new process auxiliary devices.
 - 2. New SCADA system hardware including digital process controllers (PLC based), IO modules, power modules, communication modules, network switches, UPS, and fiber optic patch panels.
 - 3. New custom control panels, control stations, junction boxes, and control power distribution panels.
 - 4. Process control system networking.

5. Submittal documentation for process systems instrumentation and control including schedules, drawings, product manuals.
 6. Maintaining construction RECORD/AS BUILT of submittal documentation and incorporating interconnection detail from other sections submittals to show accurately process systems instrumentation and control wiring as complete from circuits start and end connections.
 7. Configuration set up, calibration, testing process systems instrumentation and controls.
 8. Training.
 9. Collaboration with Programmer to provide a fully integrated PLC based SCADA system.
 10. Assemble process control hardware into customized fabricated process control panel(s).
 11. Factory test process control panel customized fabrication(s).
 12. Deliver and install process control panel customized fabrication(s) on site.
- B. PROGRAMMING: The Programmer provides process control system PLC, SCADA and OIT application programming under a separate contract.

1.3 DEFINITIONS

- A. GENERAL: Definitions of terminology related to Instrumentation and Industrial Electronic Systems used in the specifications as defined in IEEE 100, ISA S51.1, and NEMA ICS 1.
- B. VENDOR PACKAGE PROCESS CONTROL SYSTEM: A system of equipment and hardware provided by a vendor used for control, monitoring process conditions, control feedback and process performance for an associated vendor package equipment system which interfaces to the control system.
- C. TWO-WIRE TRANSMITTER: An instrument which derives operating power supply from the signal transmission circuit and requires no separate power supply connections. A two-wire transmitter produces a 4 to 20 milliampere current regulated signal in a series circuit from a 24-volt direct current driving potential and a maximum circuit resistance of 600 ohms. A two-wire transmitter is also referred to as looped power.
- D. FOUR-WIRE TRANSMITTER: An instrument which derives operating power from separate power supply connections. A four-wire transmitter produces a 4 to 20 milliampere current regulated signal in a series circuit with a maximum circuit

resistance of 600 ohms. Four-wire transmitters typically require 120Vac or 24Vdc input power supply.

- E. GALVANIC ISOLATION: Electrical node having no direct current path to another electrical node. Galvanic isolation refers to a device with electrical inputs and/or outputs which are isolated from ground, the device case, the process fluid, and separate power supply terminals. Inputs and/or outputs may be externally grounded without affecting the characteristics of the devices or providing path for circulation of ground currents.
- F. PANEL: An instrument support system which may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems including consoles, cabinets and racks. Panels provide mechanical protection, electrical isolation, and protection from dust, dirt, moisture, and chemical contaminants which may be present in the atmosphere.
- G. DATA SHEETS: Data sheets shall refer to ISA S20 or ISA TR20.00.01 latest version.
- H. SIGNAL TYPES:
 - 1. LOW-LEVEL ANALOG: Signal with full output level of 100 millivolts or less including thermocouples and resistance temperature detectors.
 - 2. HIGH-LEVEL ANALOG: Signals with full output level greater than 100 millivolts but less than 30 volts, including 4 to 20 mA transmission.
 - 3. PULSE FREQUENCY: Counting pulses emitted from speed or flow transmitters.
 - 4. DISCRETE CONTROL OR EVENTS: Dry contact closures and signals monitored by solid state equipment, relays, or control circuits typically rated for 120 volts AC or 24 volts DC.
- I. FACILITY INTEGRATOR: A firm engaged in the business of detailed control system design and engineering, custom panel fabrication, instrumentation component purchase, instrumentation tuning, system and panel assembly, and testing the specified process control and industrial automation systems.
- J. PROGRAMMER: The Owner's hired programmer providing the PLC and SCADA application programming. The Programmer shall not be a sub to the Contractor nor the facility integrator and shall be hired and paid directly by the City.
 - 1. Scada & Controls Engineering (SCE) – 20250 144th Ave NE, Woodinville, WA 98072- (425) 818-0160 email support@scadace.com
 - 2. No Substitutions

- K. OIT: Acronym for Operator Interface Terminal
- L. SCADA: Acronym for Supervisory Control And Data Acquisition
- M. PLC: Acronym for Programmable Logic Controller – synonymous with Programmable Automation Controller (PAC) for purposes of this project

1.4 QUALITY ASSURANCE

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or other- wise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
ISA S5.4	Instrument Loop Diagrams
ISA S20	Specification Forms For Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology
ISA TR20.00.01	Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations
NEMA ICS 1	General Standards for Industrial Control and Systems

1.5 FACILITY INTEGRATOR

- A. The Contractor shall engage one of the facility integrators approved by the City:
 1. Technical Systems Incorporated (TSI) – 2303 196th Street SW, Lynnwood, WA 98036 – (425) 775-5696
 2. Motor Controls Corporation (MCC) – 8030 S. 22nd Street, Kent, WA. 98032 – (253) 872-8010
 3. Quality Controls Corporation (QCC) – 5015 208th Street, Lynwood, WA 98036 – (425) 481-1225

4. No Substitutions

1.6 PROGRAMMER RESPONSIBIITY

- A. The specified and required programming of the PLCs, Operator Interface Terminal (OITs) and SCADA system shall be performed by the Programmer.
 - 1. The programming shall be consistent with that implemented at other City of Lacey lift station sites.
 - 2. The system performance shall be demonstrated to and accepted by the Owner and the Engineer.
 - 3. Programming and assistance with testing the PLC and HMI prior to and at the factory test at the Facility Integrator's shop.
 - 4. Field testing and calibration during system acceptance testing.

1.7 FACILITY INTEGRATOR RESPONSIBILITY

A. GENERAL

- 1. The specified control system and instrumentation integration including new control panels, panel modifications, instrument supply and calibration, testing, startup, operational testing, and training shall be performed by the Facility Integrator. The system shall be designed to provide the control capabilities and functions indicated and implied by the plans and these specifications and to provide trouble-free operation with minimum maintenance.
- 2. Detailed design of control panels. The drawings shall be per section 1.9D of this specification section. Changes to the layout shown in the plans must be approved by the Owner and or Engineer.
- 3. Interconnecting wiring of control equipment including Pump Control Panels, packaged equipment panels, mechanical equipment and control components, etc.
- 4. Coordinate with the Contractor for specific requirements and locations of raceway penetrations and field wiring in control panels and equipment.
- 5. Facility Integrator shall lead the effort to coordinate with the PROGRAMMER, the Contractor and the Owner and Engineer to ensure the control system meets the requirements to interconnect all controlled and monitored equipment correctly and that the PROGRAMMER is kept informed of actual PLC and network arrangements and addressing.

6. Facility Integrator shall host a one day work shop in their manufacturing facility during which the PROGRAMMER will pre load PLC and OIT programs and participate in verification of the control panel readiness for shipment to the site for installation.
7. The specified system performance shall be demonstrated to and accepted by the Owner and the Engineer.
8. The facility integrator shall provide factory acceptance testing. During the factory testing, the facility integrator shall coordinate with Owner for completion of the Owner's Witness testing standard review forms. A dedicated representative experienced in factory acceptance testing shall be provided for the duration of the testing period.
9. The facility integrator shall provide system acceptance testing. During the system acceptance testing, the facility integrator shall coordinate with Owner for completion of the Owner's Lift Station start-up package standard review forms and provide calibration of instruments as required.

B. PRE-SUBMITTAL CONFERENCE:

1. Schedule a pre-submittal conference with the Owner and Engineer within 30-calendar days after Contract award to discuss the work equipment, submittal format, and establish the framework for project coordination and communication.
 - a. Provide materials 10-days prior to the conference:
 - b. Instrument Schedule specified in Section 40 06 70 with manufacturer and model number added.
 - c. Product descriptive literature with a statement that the item is as specified.
 - d. Proposed equal products with comparative listing of the published specifications for the specified item and the proposed item.
 - e. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
2. The pre-submittal conference will not replace the Product and Shop Drawing Submittal review process.

C. PROCESS EQUIPMENT COORDINATION

1. Facility Integrators shall provide wiring interconnect diagrams for the plant process control system to interface with submitted vendor equipment panels and devices.

The wiring diagrams shall be a complete representation of the process control requirements for specific equipment. Facility Integrator coordinates to collect equipment wiring information from other Sections to show a totally wired integrated control system.

2. Integrate, furnish, and install equipment in conformance with the drawings, specifications, and the recommendations of the equipment manufacturer and the related processes equipment manufacturers.
3. Facility Integrator shall obtain manufacturer's technical information for items of equipment not provided with, but directly connected to, the control system. Provide the necessary coordination and components for correct signal interfaces between specified equipment and the control system.
4. Facility Integrator shall coordinate with project subcontractors and equipment suppliers.
5. Facility Integrator shall provide installation supervision for the duration of the project.
6. Conflicts between the plans, specifications, manufacturer/vendor drawings and installation instructions, etc., shall be presented to the Owner for resolution before proceeding.

1.8 CONTRACTOR RESPONSIBILITY

A. GENERAL

1. The Contractor shall help coordinate the work and scheduling of the Facility Integrator, Programmer, and Owner before said work and shall provide access and support for their activities.
2. The assignment of specific responsibilities herein to the Facility Integrator and Programmer shall not, in any way and under any conditions, diminish or usurp the Contractor's full and complete responsibility for all work performed and all materials installed under the contract. The contract between the Contractor and the Facility Integrator and Programmer shall specifically require that the Facility Integrator and Programmer conform to and meet all requirements of the contracting Agency and as specified herein.
3. Responsibilities include, but are not limited to:
 - a. Review the Facility Integrator's submittals and wiring diagrams for coordination with programming, space requirements, raceway requirements of field wiring, etc.

- b. Supplying the Facility Integrator with submittals of equipment related to the control system which the Facility Integrator must include in their submittals and incorporate into the work, such as motors, packaged control panels, metering enclosures, power distribution panels and enclosures, etc. which the Facility Integrator does not build or provide.
- c. Installation of all electrical panels including those supplied by the Facility Integrator.
- d. Installation of the interconnecting wiring per the Facility Integrator's wiring diagrams.
- e. Installation of instruments per detailed contract drawings or drawings and instructions supplied by the Facility Integrator.
- f. Coordinate with the Owner inspector for scheduling instrumentation commissioning/pre-start inspection. The Contractor and their electrical subcontractor shall be present for the instrumentation commissioning/pre-start inspection.
- g. The Contractor shall be required to complete any punch list items from the Owner that are a result from the pre-start inspection.

1.9 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
- 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided. Edit to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - 2. Provide Seismic calculations for anchoring and support of equipment as required.
 - 3. Manufacturer's installation instruction excerpts that apply to this project:
 - a. Mounting requirements
 - b. Electrical connection diagrams
 - c. Calibration procedures
 - d. Operation and maintenance information
 - e. Warranty information
- D. SUBMITTAL DRAWINGS
- 1. GENERAL
 - a. Prepare drawings in latest version of AutoCAD with borders and title blocks identifying the project and system.
 - b. Diagrams shall carry a uniform and coordinated set of wire numbers and terminal block numbers. The wire numbers shall match the Owner's original drawings to the best extent possible.
 - c. Drawings shall contain every detail contained in the Owner's original drawings. Every component and symbol shall be represented.
 - d. Loop drawing numbers and file names are to be based on equipment tag numbers
 - e. Provide the following submittal drawings

- 1) Arrangement and layout drawings
 - a) Contract document's drawings are typical illustrations of panel hardware/component arrangement and layouts representing one or more than one panel with similar interconnection requirements. Provide the unique panel arrangement, layout and outline drawings. Show arrangement and layout to scale. Add components and wiring to the unique panel drawings as required to complete a fully integrated operation. Include on the drawings a Bill of Material that identifies all components in the arrangement and layout.
- 2) Schematic diagrams
 - a) Show components of a control panel in an arrangement similar to the actual layout of the panel including internal wiring between devices include IO module layout connections. Show terminal blocks used for internal wiring or field wiring, identified as such.
 - b) Wire labels shall have the same description and numbers as practical as possible to the Owner's original drawings.
- 3) Loop diagrams
 - a) Provide the unique loop diagram for each piece of equipment.
- 4) Network block diagram
 - a) A network block diagram is a diagram of the control system, with annotated boxes to show the primary network components (controllers, hubs, switches, computers, displays), and annotated interconnecting lines that show the system communication media and communication protocols).

PART 2 PRODUCTS

2.1 GENERAL

A. MATERIALS AND QUALITY:

1. Provide process control hardware new, free from defects, and industrial- grade, as specified. Each type of instrument, instrument accessory, and device used throughout the work shall be manufactured by one firm, where possible.

2. Electronic process control hardware shall be of solid-state construction with printed or etched circuit boards of glass epoxy of sufficient thickness to prevent warping.

B. ENCLOSURES: NEMA rating for the location and application shown herein and as specified in Section 40 67 16, Division 26, and as shown on the drawings.

Location	Enclosure Material and NEMA Rating
Main Control Panel Interior	NEMA 1 & 12: mild steel
Main Control Panel Outdoor	NEMA 3R: 304 Stainless Steel
Isolation Pedestal Outdoor	NEMA 4X: 316 Stainless Steel
Process Corrosive	NEMA 4X: 316 Stainless Steel
Chemical Corrosive	NEMA 4X: 316 Stainless Steel
Hazardous Area:	NEMA 7: Galvanized Malleable Iron or Aluminum or NEMA 4X and UL listed or FM Approved for the Hazardous Area.

C. For the purposes of this project, the enclosures shall be as listed in the Bill of Materials in the Owner's original drawings.

2.2 NAMEPLATES

A. Provide nameplates for all field mounted instrument, analyzer, or equipment. Include the equipment title, the equipment tag number, and power source(s) in the nameplate inscription. Provide machine engraved laminated black phenolic nameplates with white lettering for equipment identification with 1/8-inch-high lettering.

2.3 SPARES:

A. Provide 10% spare for most components or at least one spare for each panel component unless a larger specific requirement is listed herein.

1. Power Supplies – 1 of each type used
2. Terminal Blocks – 5 of each type used
3. Terminal Fuses – 5 of each type used
4. Power Monitor Fuses – 3 each
5. Surge Protection Devices – 1 of each type used
6. Standard Relays – 2 of each type used
7. Time Delay Relays – 1 of each type used
8. Intrinsic Relay – 1 of each type used
9. Relays Bases – 1 of each type used
10. UPS - 1 of each type used

11. PLC Modules – 1 of each type used, not including CPU.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install process control hardware in locations that are accessible for operation and maintenance services. Process control hardware not accessible shall be reinstalled at no cost to the Owner.
- B. Install process control hardware in accordance with product manufacturer's requirements.
- C. Ensure process control hardware is grounded per NEC and manufacturer's requirements.
- D. Provide proper clearance for process control hardware for heat dissipation and access.
- E. Ensure UL/FM or equal listings/markings/labels are viewable after installation.
- F. Provide secure mounting of all process control hardware (such as DIN rail mount).
- G. Provide electrical circuit protection for process control hardware if not integral.
- H. The control system panels and other electrical equipment shall not be shipped to the site until a suitable environment is available for installation of the equipment. A suitable environment for the purposes of this contract for the control cabinet shall be the completed foundation with conduit stubs and anchor points, and electric service available within 24 hours. Prior to shipment of electrical equipment, the Contractor shall contact the Engineer or Owner's representative for field verification of a suitable environment.
- I. The control system panels shall be installed by the Contractor or, at the option of the Contractor, by the manufacturer or the panel in accordance with the installation drawings and instructions prepared by the manufacturer. Installation shall be performed by workers who are skilled and experienced in the installation of industrial electrical instrumentation and control systems.
- J. Installation shall include all elements and components of the panels and all interconnecting wiring between the equipment, components, and sensors. All wiring between cabinets, sensors and equipment shall be labeled at all ends with designations that are uniform and consistent with the system used by the Facility Integrator. All terminals shall be made with solderless pressure connectors. All wiring shall be in accordance with the requirement of Section 26 05 19. Intrinsically safe wiring shall have separation barriers in accordance with NEC requirements.

3.2 INSPECTION AND VERIFICATION OF INSTALLATION

- A. After completion of the installation of the panels, the manufacturer or supplier shall inspect the installation and verify that all components and wiring are correctly installed. The manufacturer or supplier shall determine the exact scope and nature of work required to correct deficiencies and errors in the work and shall supervise the performance of such work.

3.3 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. FACTORY ACCEPTANCE TEST (FAT): Facility Integrator shall schedule a FAT of all items for the City to test and inspect and provide comments for repair and make changes based on the approved submittal. All items noted for change shall be completed prior to delivery to site for installation. The Contractor shall schedule the FAT at least 2 weeks ahead of test date with approval of City. The Facilities integrator shall provide a dedicated representative to be present for the duration of the FAT.
- C. SYSTEM (pre-startup) TEST: The test shall demonstrate stable operation of all PLC I/O modules, wiring, and data transmission to the OIT under actual operating or simulated conditions. The test shall also demonstrate proper operation of all digital or sequential control. All start/stop, open/close, raise/lower and similar commands and all discrete status inputs shall be tested for proper operation. In addition, all alarms, both analog and discrete, shall be tested. The Contractor shall schedule the system test at least 2 weeks ahead of test date with approval of City.
- D. SYSTEM ACCEPTANCE (startup) TEST (SAT): The SAT shall be completed in full operation and to demonstrate that all functional requirements of this specification and contract documents have been met. The Contractor shall schedule the SAT at least 2 weeks ahead of test date with approval of City. The Facilities integrator shall be present for the duration of the startup.
- E. DELIVERY INSPECTION: Notify the Owner upon arrival of any material or equipment to be incorporated into the work. Remove protective covers or otherwise provide access in order that the City may inspect such items.

3.4 MANUFACTURER'S SERVICES

- A. TRAINING: Provide a factory-trained manufacturer's representative or Facility Integrator skilled in equipment use at the Site for the following activities. Specified durations do not include travel time to or from the Site.
 - 1. During start up and commissioning of the instrumentation provide training to demonstrate the use, calibration and maintenance of all supplied instrumentation. Minimum of 2 training sessions each spanning two 8-hour days shall be provided.

2. During startup of the control system provide training to demonstrate the use of the SCADA system to operate the facility as modified by this contract. Minimum of 2 training sessions each spanning one 8-hour day shall be provided.
 3. Prior to startup of the control system provide training to demonstrate the use of the SCADA system to operate the facility as modified by this contract. Minimum of 2 training sessions each spanning two 4-hour periods shall be provided.
- B. Coordinate training at least 2 weeks in advance with operations and maintenance staff schedules to ensure all required staff can attend.
 - C. Training to include configuration, operation, trouble shooting, wiring, calibration, testing, installation, safety, and warranty coverage for each process control hardware type.
 - D. Certify completion of training.

3.5 OPERATION AND MAINTENACE MANUALS

- A. The Facility Integrator shall prepare and assemble detailed operation and maintenance manuals in accordance with the project general requirements and specifications as set forth in Section D: Special Provisions Section 7-22.3(3)B. The manuals shall also include, but not be limited to the following:
 1. Electronic copy on USB drive of all shop drawings in AutoCAD format, editable and unlocked.
 2. As-built wiring diagrams of cabinets and enclosure contained assemblies and of the overall system.
- B. The Programmer shall provide:
 1. Program documentation printout with tag numbers and descriptive comments.
 2. RS Logix Project Report
 3. Backup program, unlocked or without password on USB drive.

3.6 WARRANTY

- A. The Contractor shall guarantee the control system, installation and all other work performed under the contract to be free of defects in design, materials, and workmanship for a period of (1) year following the date of acceptance by the Owner.

- B. As part of the warranty, the Contractor and the Facility Integrator shall indemnify and hold harmless the Owner, the consultant and their officers, agents and employees against and from all claims and liability arising from all damage and injury due to defects in the control system and installation.

- C. The Contractor shall ensure the Facility Integrator make any and all repairs, replacements, modifications and adjustments required to eliminate any and all defects in design, materials and workmanship which are disclosed within one year guarantee period. The Facility Integrator shall begin repairs, replacements, modifications and adjustments within twenty-four (24) hours of notification by telephone by the Owner and shall complete such repairs, replacements, modification and adjustments within forty-eight (48) hours of notification. Should the Facility Integrator fail to begin the work within 24 hours or complete the work within 48 hours, the Owner may proceed to undertake or complete the work. In such event, the Contractor and his surety shall be liable for all costs incurred by the Owner.

3.7 INSTRUMENT TEST FORMS

- A. The City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix, shall be used for all devices requiring calibration and or verification. Forms shall be submitted to the Engineer or Owner's representative prior to requesting final acceptance.

END OF SECTION

SECTION 40 61 21

PROCESS CONTROL SYSTEM TESTING

PART 1 GENERAL

1.1 SUMMARY

- A. This section specifies Contractor and Facility Integrator requirements for testing and documenting the process instrumentation and control system for automation integration with SCADA in conjunction with the Owner's Programmer.
- B. The term instrumentation covers field and panel instruments, analyzers, primary sensing elements, transmitters, power supplies, and monitoring devices.
- C. Provide the labor, tools, material, power, and services necessary to provide the process instrumentation and control system inspection and testing specified herein. Coordinate all test procedures with the requirements of the City of Lacey Section D: Special Provisions and the Lift Station Pre-Startup and Startup checklists.
 - 1. Include the following action items
 - a. Develop test plan.
 - b. Develop record keeping system.
 - c. Coordinate testing with the Owner's Programmer.
- D. Testing to include:
 - 1. Pre-Operational - Factory Acceptance Testing (FAT)
 - 2. Component Testing Sequence:
 - a. Wiring Testing
 - b. Piping Testing
 - c. Installation Inspection
 - d. Instrumentation Calibration
 - e. Loop Testing
 - f. Network Testing
 - 3. System (Functional) Testing Sequence:
 - a. Process Control Strategy/Sequence Testing
 - b. Control System Closed Loop
 - c. Functional Checkout

- 4. Operational Testing:
 - a. System Acceptance Testing (SAT)
- E. Definitions: Section 40 61 13 and for definition of System Integrator and Owner's Programmer.

1.2 QUALITY ASSURANCE

A. TESTING MANAGER:

1. The Contractor or Facility Integrator shall appoint a qualified specialist as process control system testing manager to manage, coordinate, and supervise the testing work.
2. The Testing Manager requires at least 5 years of total experience, or experience on at least five separate projects, in managing the testing and startup of electrical and instrumentation control systems of equal or greater scope and complexity. Testing Manager to provide a quality assurance program which includes:
 - a. Definition of process areas and systems, with testing executed on an area-by-area basis, based on the drawings.
 - b. Sequential list of the test phases required for each process area and system.
 - c. Completion status tracking form by process area, system, and test phase.

B. REFERENCES: Section 40 61 13.

1.3 SUBMITTALS

A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- C. Organize the submittal items in the following manner for review.
1. Qualifications
 - a. Testing Manager Qualifications and resume
 - b. Network testing entity qualifications and staff performing inspections and testing.
 2. Test Plans and forms
 - a. I/O Interface Summary in accordance with the requirements of paragraph 40 61 21-2.2 C.
 - b. Testing status spreadsheet in accordance with the requirements of paragraph 40 61 21-2.2 A. 3.
 - c. Test procedures in accordance with the requirements of paragraph 40 61 21-3.1 D and per Section 40 61 13 3.3.
 - d. Proposed test forms per PART 3 of this Section 40 61 21, detailed for each test for this project.
 - e. Certified Factory Calibration Reports.
 - f. Provide up to date, as constructed control system drawings in accordance with paragraph 40 61 13 - 1.2 A 6.
 - g. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be

provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- h. Provide Contractor's adapted version of Section 40 06 70 Schedules of Instrumentation. This list is to be maintained throughout construction to reflect as-built conditions.

3. Factory Acceptance Test Information

- a. Submit location, time, date and duration for Factory Acceptance Testing.
 - 1) Update scheduling of this test periodically. Do not change location and date of test less than two week prior to commencing.

4. Completed Test Forms:

- a. Completed test forms per PART 3. Separate submittals may be provided for each process area or system.
- b. List of factory calibrated items and calibration certificates.
- c. Documentation of network data communication nodes for networked controllers, remote I/O and related devices.
- d. Final Test Report assembled in a three-ring binder and submitted at the completion of the inspection and testing activities for a facility.
 - 1) Label the binder cover and spine to identify the project name and facility. Test report includes the applicable test procedures for the facility and the completed inspection and test report forms associated with the equipment and systems of that area.
 - 2) Organize test results by equipment item or system with individual, labeled tab dividers to identify each. System deficiencies and non-compliant test results identified in the final test report and acknowledged by the responsible party as having been corrected.

PART 2 PRODUCTS

2.1 GENERAL

- A. The Testing Manager shall provide test forms, documentation, and records as specified in the following paragraphs.

2.2 TESTING DOCUMENTATION

- A. DOCUMENTATION RECORDS: The Testing Manager shall develop a record keeping system to document progress and completion for each task in each process area or system. Keep the following current and available for inspection on-site at all times in a location designated by the Owner:
1. Testing Manager's qualifications, project startup and testing history, including resume as specified in this Section.
 2. List of names of Contractor's and System Integrator's personnel associated with final construction and testing, and normal and emergency contact telephone numbers
 3. Testing Status spreadsheet with breakdown for each process area and process system, with percentage complete on each testing sequence task.
 4. Test Report Volumes.
- B. TEST REPORT VOLUMES: The Contractor develops and maintains testing documentation for each area of the facility in separate volumes. Keep each volume current and available for inspection on-site at all times in a location designated by the Owner. Each volume includes the following as a minimum:
1. Three-ring binder with front cover and spine labeled: "Testing Documentation For Process Area / Process System" including Owner's name, facility name, project name, and project number.
 2. Table of Contents with same labeling as the volume cover with tabs for each section:
 - a. Section 1 – I/O Interface Summary
 - b. Section 2 – Schedules for Integrated Automation Instrumentation and Terminal Devices
 - c. Section 3 – Test Forms
 - d. Section 4 – Certified Factory Calibration Reports
 - e. Section 5 – Final Test Report
- C. I/O INTERFACE SUMMARY: Provide I/O spreadsheets for each area of the facility based on the drawings. Spreadsheets to include the following for each I/O point:
1. Signal number/tag

2. Annotation description that may be logically abbreviated and that is subject to approval.
 3. Complete physical I/O channel designation and addressing or communication I/O register designation.
 4. True/False status designations for digital I/O.
 5. Process range; engineering units and any multipliers; and raw signal range count for analog I/O.
 6. Signals: Fixed point and scaled at the Controller with minimum four significant implied digits of scaling. E.g.: 0 to 1400 at Controller for a pH range of 0 to 14 at Operator Interface.
 7. Provide Operator Interface scaling to display decimal digits required.
 8. Test result - pass or fail and date of test.
 9. Maintain in Excel with electronic updates to Owner issued within 2 days after each test after any updates or changes by Contractor.
- D. SCHEDULES FOR INTEGRATED AUTOMATION INSTRUMENTATION AND TERMINAL DEVICES: Provide a detailed Schedule for Integrated Automation Instrumentation and Terminal Devices. Use the as-built Schedules for Integrated Automation Instrumentation and Terminal Devices submitted in Section 40 06 70. Provide details on calibration ranges, set points, and dead bands.

PART 3 EXECUTION

3.1 GENERAL

A. GENERAL REQUIREMENTS:

1. Prior to testing, provide notice to the Owner. Provide notice between 60 and 70 days before starting any testing activity, and include a detailed step-by-step test procedure complete with forms for the recording of test results, testing equipment used, and a place for identification of the individual performing or, if applicable, witnessing the test.
2. Facility integrator to provide detail assistance to the Contractor in generating test forms, customized for this project.

3. In addition to the customized testing sheets the testing procedure shall incorporate and comply with the City's Lift Station Pre-startup and Pump Startup Check list and associated instrumentation forms as attached in the Appendix.

B. TECHNICIAN QUALIFICATIONS:

1. Calibrate and set up field instruments and analyzers using a certified instrument technician qualified to calibrate the instrumentation.
2. Technicians are to be qualified by completion and certification from training courses offered by the Instrumentation, Systems, and Automation Society (ISA), the instrumentation and analyzer manufacturer's training courses, or technician training courses at a recognized trade school that specializes in instrumentation calibration.

C. TEST EQUIPMENT AND MATERIALS:

1. Provide test equipment to conduct the specified tests that simulate inputs and read outputs with a rated accuracy at the point of measurement at least three times greater than the component under test.
2. Ensure test instruments have a current calibration sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required. Include certified calibration reports traceable to the National Institute of Standards and Technology with the final test report.
3. Provide a documenting calibration system to conduct process instrumentation calibration activities that consist of a documenting process calibrator and an instrumentation data management software system that captures the calibration results and electronically documents instrument data, date of calibration, calibration procedures, and as-found and as-left instrument calibration data.
4. Provide an instrument calibration system such as Fluke 743B with Fluke DPC/Track Instrumentation Management software or similar system. Submit calibration files with the final test report in hard copy and electronic formats that do not require specialized equipment or software to read and print the files.
5. Provide buffer solutions and reference fluids for tests of analytical equipment.
6. Vendor software tools may document the systems where a licensed copy of the identical software including connectors, cables, keys, interface cards and devices required for operation is submitted with the final documentation files.

D. FIELD TEST PROCEDURE DOCUMENTATION:

1. Organize and assemble in separate volumes for each process area test procedures for each analog and discrete loop in the process control system. Submit final test records in electronic form by scanning and converting the records and files to Adobe PDF format, to preserve actual signatures and signoffs.
2. Include test procedure documentation with detailed step-by-step description of the required test procedure, panel and terminal block numbers for points of measurement, input test values, expected resultant values, test equipment required, process setup requirements, and safety precautions.
3. Include test report forms for each loop covering wiring, piping, and individual component tests. Record the actual test results on these forms and assemble a final test report as specified in this Section.
4. Preprint and complete test report forms to the extent possible prior to commencing testing. Include for test report forms that document the field test procedures the following information:
 - a. Project name
 - b. Process area associated with the equipment under test.
 - c. Instrument loop description.
 - d. Instrument loop identification number.
 - e. Instrument nameplate data.
 - f. Instrument setup and configuration parameters.
 - g. Time and date of test.
 - h. Inspection checklist and results.
 - i. Reference to applicable test procedure.
 - j. Expected and actual test results for each test point in the loop including programmable controller data table or register values.
 - k. Test equipment used.
 - l. Space for remarks regarding test procedure or results, unusual or noteworthy observations, etc.
5. Name, date, and signature of testing personnel
6. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

E. WITNESSING

1. The Owner reserves the right to observe factory and field instrumentation testing and calibration procedures. Notify Owner and Owner's System Programmer prior to testing, as specified herein and per Section 40 61 13.

END OF SECTION

SECTION 40 62 63

OPERATOR INTERFACE TERMINALS (OIT)

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Product Requirements
 - 6. Installation
 - 7. Testing

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of an Operator Interface Terminal (OIT).
- B. Provide and test OIT with programmable logic controller and other process control hardware specified to form a functional process control system (PCS).
- C. Provide OIT with screen size as specified on the drawings with sufficient RAM memory to support the visualization programming requirements of the application including screen navigation, alarming, datalogging, etc.

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer’s Association
- C. NEC – National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
 - 3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

- C. Manufacturer's installation instructions.
- D. Operation and Maintenance Manual if applicable.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. To ensure compatibility and spare parts used by the City's existing SCADA and control systems, the manufacturers and models shall be the following:
 - 1. Maple Systems cMT2108X2

2.2 GENERAL

- A. The Operator Interface Terminal will be a system consisting of a Maple Systems cMT2108X2, any required panel mounting parts, and any ancillary equipment unless otherwise noted.

2.3 ENVIRONMENTAL REQUIREMENTS

- A. Operating Temperature: 32 to 122 degrees F.
- B. Storage Temperature: -4 – 140 degrees F
- C. Relative Humidity: 10% – 90% (non-condensing)
- D. Vibration Tolerance: 10 to 25 hertz at 2 G peak acceleration for 30 minutes.
- E. NEMA/UL Type 4/4X (indoor use) and IEC IP66 compliant front panel.
- F. Certifications: cULus, CE, RoHS.

2.4 FEATURES

- A. 10.1" Thin Film Transistor (TFT) Color graphic display
- B. Four-wire resistive touch
- C. Brightness: 350 (cd/m²)
- D. Active Area Accuracy: Length (X) +/- 2%, Width (Y) +/- 2%
- E. Size: 8.82 x 4.96 inches (224 x 126 mm)
- F. Max resolution: 1024x600

- G. Backlight lifetime: 50,000+ hours

2.5 ELECTRICAL REQUIREMENTS

- A. Supply Voltage: 24 +/- 20% VDC @ 1A (24 W).
- B. Built in power isolation and 50 MΩ at 500 VDC isolation resistance.
- C. Voltage resistance: 500VAC (1 min.)

2.6 MECHANICAL REQUIREMENTS

- A. Enclosure: black plastic
- B. Coated Printed Circuit Boards (PCB)
- C. Dimensions: 10.67 x 8.39 x 1.50 inches (271 x 213 x 38 mm)
- D. Weight: ~2.65 lbs. (1.2 kg)
- E. Mounting: Panel Mounted

2.7 COMMUNICATION REQUIREMENTS

- A. Communication protocol compatible with the PLC as listed on the drawings.
- B. Two serial connections; 1 x DE9P COM1: RS-232, COM3 RS-232, 1 X DE9S COM2: RS-485 2 or 4 wire, COM3: RS-485 2 wire.
- C. One LAN connection; 1 x 10/100 Base-T RJ-45, 1 x GbE RJ45
- D. One USB 2.0 port

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Install Operator Interface terminal per manufacturer's instructions.
- C. The screens for the operator interface terminal shall be consistent with the layout of the existing operator interface screens within the system. Consult with Owner to provide access to those stations for preview whom may provide a copy of the current programming of one of the stations upon request.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. In addition, the OIT shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed system.
- C. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 40 63 43

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. Programmable logic process controllers are also known as programmable logic controllers (PLCs) and central processing unit (CPU). This section specifies general requirements for programmable logic process controllers and I/O Modules
- B. Section includes:
 - 1. Scope
 - 2. Quality Assurance
 - 3. Submittals
 - 4. Performance Requirements
 - 5. Products
 - 6. Installation
 - 7. Testing
 - 8. Manufacturer's Services

1.2 SCOPE

- A. Provide and test programmable logic process controllers with other process control hardware specified to form a functional process control system (PCS) integrated into the City's existing supervisory control and data acquisition (SCADA) system.
- B. Provide programmable logic process controllers sized for the input/output requirements as specified on the drawings. Provide programmable logic process controllers sized for executing the control sequences PLC and SCADA logic.

1.3 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials

1.4 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

C. Product Data: For each type of device and system:

1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided

D. Manufacturer's installation instructions.

E. Operation and Maintenance Manual if applicable.

PART 2 PRODUCTS

2.1 CANDIDATE MANUFACTURERS

- A. To ensure compatibility and spare parts used by the City's existing SCADA and control systems, the programmable logic controller shall be Rockwell Automation, (Allen-Bradley PLC), CompactLogix System processor with I/O modules.

2.2 MATERIALS

- A. Provide new, free from defects, an industrial-grade logic controller as specified within this Section.
 - 1. Controller - 1769-L33ER
 - 2. Power Supply – 1769-PB2
 - 3. 16-point DC Digital Input Modules - 1769-IQ16
 - 4. 8-point Relay Output Module – 1769-OW8
 - 5. 4-channel Analog Input Module - 1769-IF4
 - 6. End Cap Module – 1769-ECR
- B. All field devices shall be wired to terminal blocks, before connection to PLC or I/O modules. Direct connection from field devices to modules will not be accepted.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation requirements: Processor and I/O to be din-rail mounted inside the pump control panel as specified in Section 40 61 13 and on the drawings.

3.2 TESTING

- A. Testing requirements specified in: Section 40 61 21.
- B. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 40 67 16

CONTROL PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Panel Information
 - 3. Panel Design
 - 4. Quality Assurance
 - 5. Submittals
 - 6. Performance Requirements
 - 7. Products
 - 8. General

1.2 SCOPE

- A. This section specifies requirements for process control panels and hardware required for custom fabrication.
- B. Provide the instrument, control, and monitoring features indicated on the electrical drawings. Panels shall be arranged to separate control and instrument devices from power wiring. Panel shall be arranged for dedicated field wiring terminations rated for 600 Vac or less for power, control, and instrument signal wiring shall be fabricated by a UL-508A recognized facility and shall bear the appropriate UL 508A Industrial Control Panel label. Panels for Hazardous (Classified) Locations shall bear the appropriate UL 698A label.
- C. Panels that contain programmable logic controllers (PLC) are as shown on the drawings.
- D. Comply with the specified products in Sections 40 61 13. Panels that do not comply with the specified products and specified logic method, hardwired or PLC logic, shall not be accepted. Cost to retrofit the panel as specified shall be borne by the panel supplier. Corrections or modifications to UL 508A Industrial Control Panels shall be transported to the panel supplier's facility for corrections, testing, relabeling and inspection.
- E. Field modifications require a UL inspector site inspection for approval of panel corrections and to re-label the panel after the field modifications are completed.

- F. Submittal drawing requirements specified in City of Lacey Section D: Special Provisions and Section 40 61 13.
- G. Label panels with fault current rating per NEC article 409.110.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
 - 1. American National Standards Institute (ANSI).
 - 2. ASTM International (ASTM):
 - a. B75, Standard Specification for Seamless Copper Tube.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 4, Industrial Control and Systems: Terminal Blocks.
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 5. Underwriters Laboratories, Inc. (UL):
 - a. 508A, Standard for Safety Industrial Control Panels.
 - b. 913, Standard for Safety, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.
 - c. 698A, Industrial Control Panels Relating to Hazardous (Classified) Locations.

1.4 DEFINITIONS

- A. The term "panel" refers to control panels or enclosures listed in the schedule included in this Section.
- B. Foreign Voltages: Voltages that may be present in circuits when the panel main power is disconnected.

1. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under test conditions as prescribed in UL 913.
- C. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- D. Instrumentation Cable:
 1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
 2. Instrumentation cable is typically either TSP (twisted-shielded pair) or TST (twisted-shielded triad) and is used for the transmission of low current or low voltage signals.
- E. Ground Fault Circuit Interrupter (GFCI): A type of device (e.g., circuit breaker or receptacle) which detects an abnormal current flow to ground and opens the circuit preventing a hazardous situation.
- F. Programmable Logic Controller (PLC): A specialized industrial computer using programmed, custom instructions to provide automated monitoring and control functions by interfacing software control strategies to input/output devices. Synonymous with Programmable Automation Controller (PAC) for purposes of this project
- G. Remote Terminal Unit (RTU): An industrial data collection device designed for location at a remote site, that communicates data to a host system by using telemetry such as radio, dial-up telephone, or leased lines.
- H. Input/Output (I/O): Hardware for the moving of control signals into and/or out of a PLC or RTU.
- I. Supervisory Control and Data Acquisition (SCADA): Used in process control applications, where programmable logic controllers (PLCs) perform control functions but are monitored and supervised by computer workstations.
- J. Digital Signal Cable: Used for the transmission of digital communication signals between computers, PLCs, RTUs, etc.
- K. Uninterruptible Power Supply (DC UPS):
 1. A backup power unit that provides continuous power when the normal power supply is interrupted.
 2. Provided in Main control cabinet as shown on the drawings.

3. Sized to provide a minimum of 4 hours of continuous operation of all connected components or as listed on the drawings or in the specifications.
- L. Loop Calibrator: Portable testing and measurement tool capable of accurately generating and measuring 4-20ma DC analog signals.

1.5 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials
- C. Entire assembly shall be affixed with a UL 508A or 698A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.
- D. Each panel shall have an affixed fuse identification list.
- E. Each panel shall have the affixed vinyl and phenolic legends as shown on the drawings.
- F. Each panel shall have an affixed power and short circuit rating label.

1.6 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Submittal items required include:
- 1. Submit items specified in Section 40 61 13
 - 2. Arrangement and Layout Drawings
 - 3. Exterior panel layout
 - 4. Interior panel layout
 - 5. Bill of Materials
 - 6. PLC I/O list
 - 7. Door-in-door construction devices, where required
 - 8. Sections showing clearances between face and rear mounted equipment.
 - 9. Connection Diagrams.
 - 10. Phenolic Nameplate and engraving schedule: (at a minimum, shall be as shown in the drawings)
 - a. Indicate engraving by line
 - b. Character size
 - c. Nameplate size
 - d. Panel and equipment tag number and description
 - 11. Vinyl label schedule: (at a minimum, shall be as shown in the drawings)
 - 12. Heat load calculations for each cabinet based on the highest ambient temperature for the area in which the subject panel will be located.
 - 13. Power supply calculations.
 - 14. Manufacturer's operation and maintenance information as specified in City of Lacey Section D: Special Provisions Section 7-22.3(3)B. Manual shall include final reviewed submittal redlined to show AS BUILT conditions; and separate record of all final configuration, jumper, and switch settings.
 - 15. Climate control calculations for each panel.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Enclosures (See drawings for specific models)
 - 1. Nvent/Hoffman Enclosures, Inc
 - 2. Or as approved by Owner.
- B. Panel Heaters (See drawings for specific models)
 - 1. Nvent/Hoffman Enclosures, Inc.
 - 2. Pfannenbergl
- C. Ventilation Fans and hoods (See drawings for specific models)
 - 1. Rittal
- D. Thermostat and Hygrostat (See drawings for specific models)
 - 1. Stego.

2.2 FABRICATION

- A. General:
 - 1. Fabricate panels with instrument arrangements and dimensions identified in the Contract Documents.
 - 2. Provide panel(s) with the required enclosure rating per NEMA 250 to meet classifications identified in the Contract Documents.
 - 3. Devices installed in panel openings shall have a NEMA enclosure rating at least equal to the panel enclosure rating.
 - 4. Short circuit current rating of panel:
 - a. 10,000A, minimum.
 - 5. Panels and pedestals to be located outdoors shall be fabricated from 316 stainless steel and shall utilize appropriate hinge and locking components. Panel(s) shall be completely assembled at the Contractor's factory:
 - a. No fabrication other than correction of minor defects or minor transit damage shall be performed on panels at the jobsite.
 - 6. Painting:

- a. Panels fabricated from steel shall have their internal and external surfaces prepared, cleaned, primed, and painted:
 - 1) Mechanically abrade all surfaces to remove rust, scale, and surface imperfections.
 - 2) Provide final surface treatment with 120 grit abrasives or finer, followed by spot putty to fill all voids.
 - 3) Utilize solvent or chemical methods to clean panel surfaces.
 - 4) Apply surface conversion of zinc phosphate prior to painting to improve paint adhesion and to increase corrosion resistance.
 - 5) Electrostatically apply polyester urethane powder coating to all inside and outside surfaces.
 - 6) Bake powder coating at high temperatures to bond coating to enclosure surface.
 - a) Panel interior shall be white with semi-gloss finish.
 - b) Panel exterior shall be ANSI #61 gray with flat finish.
 - 7) Application of alkyd liquid enamel coating shall be allowed in lieu of polyester urethane powder for wall mounted NEMA 12 rated panels
 - b. Panels fabricated from stainless steel, aluminum, or fiberglass shall not be painted.
7. Finish opening edges of panel cutouts to smooth and true surface conditions:
- a. Panels fabricated from steel shall have the opening edges finished with the panel exterior paint.
8. Panel shall meet all requirements of UL 508A
- a. If more than one (1) disconnect switch is required to disconnect all power within a panel or enclosure, unless otherwise required by UL 508A, provide a cautionary marking with the words "CAUTION" and the following or equivalent, "Risk of Electric Shock-More than one (1) disconnect switch required to de-energize the equipment before servicing."
9. Provide control panel in accordance with NEC Article 409 - Industrial Control Panels:

- a. In the event of any conflict between NEC Article 409 and UL 508A, the more stringent requirement shall apply.
10. Panel shall meet all requirements of UL 698A
- a. Provide intrinsically safe circuit extensions from panels in unclassified locations into hazardous classified locations in accordance with the NEC as required by UL 698A.
- B. Wall Mount, Free-Standing or Pedestal-Mounted Panels:
- 1. Welded construction.
 - 2. Completely enclosed, self-supporting and gasketed dust-tight.
 - 3. Rolled lip around all sides of enclosure door opening.
 - 4. Seams and corners welded and ground smooth to touch and smooth in visual appearance.
 - 5. Full height, fully gasketed flush pan doors.
 - 6. Full length piano hinges rated for 1.5 times door plus instrument weight.
 - 7. Doors with 3-point latch and L-shaped, quarter-turn padlockable handles.
 - 8. Appropriate conduit, wiring, and instrument openings shall be provided.
 - 9. Lifting eyebolts:
 - a. To allow simple, safe rigging and lifting of panel during installation.
 - b. Removed, holes plugged, and eyebolts stored inside respective enclosure.
 - 10. Main control cabinet and isolation pedestal enclosures shall be constructed of a minimum of 14-gauge stainless steel.
 - 11. Main control cabinet to be furnished with the following:
 - a. Factory installed drip shield and drain holes in enclosure bottom per (UL 3R).
 - b. Padlockable handle.
 - c. Door stop kits, bottom of both doors.
 - d. Folding 12" x 12" shelf located on the inside left door.

12. Where double doors are provided, doors shall be gasketed and overlapping without the need for centerpost.
- C. Internal Panel Lighting and Service Receptacles:
1. One (1) electrical GFCI duplex receptacle as shown on the drawings.
 2. Two (2) 24-inch 120V LED strip light fixture with daisy chain connectors as shown on drawings. Model: Cooper HU1124D9P with mounting accessories and connectors.
- D. Component Mounting and Placement:
1. Components shall be installed per manufacturer instructions. Double-faced tape will not be permitted.
 2. Control relays and other control auxiliaries shall be mounted on DIN rail mounting channels where practical.
 3. Terminal blocks shall be mounted in the enclosures with ample clearance to allow visual guidance for installing wires.
 4. Front panel devices shall be mounted within a range of 40 to 70 inches above the finished floor or grade, unless otherwise shown in the Contract Documents.
 5. PLC and I/O rack module installation:
 - a. Located such that the LED indicators and switches are readily visible with the panel door open.
 - b. Located such that calibration, repair and/or replacement of component can be accomplished without the need to remove wire terminations or other installed components.
 - c. Locate controller with sufficient spacing for circulation of air.
 - d. Where components such as contactors, and other electromagnetic devices are installed within the same enclosure as the PLC system components, provide a barrier of at least 6-inch of separation between the “power area containing the electromagnetic devices” and the “control area”.
 6. Components mounted in the panel interior shall be fastened to an interior sub-panel using machine screws:
 - a. Fastening devices shall not project through the outer surface of the panel enclosure.

7. Locate and install all devices and components so that connections can be easily made and ample room is provided for servicing each item.
 8. OITs shall be installed at 5'6" to center of screen for finished floor or walkway directly in front of the install location. In the event mounting height is unclear due to other information or situations, Contractor shall submit an RFI to verify desired mounting height before proceeding with installation.
- E. Follow UL recommendations.

2.3 CONTROL DEVICES

- A. Selector switches, push buttons and indicating lights to be provided in accordance with Section 40 78 19.
- B. Terminal blocks, and relay to be provided in accordance with Section 40 78 53.
- C. Intrinsically safe barriers and surge suppressors to be provided in accordance with Section 40 78 56.
- D. Programmable logic controllers to be provided in accordance with Section 40 63 43 and as shown on the drawings.

2.4 MOTOR CONTROL EQUIPMENT

- A. Motor control equipment shall be provided in accordance with Section 26 29 13 13 and as shown on the drawings.

2.5 DIRECT-CURRENT POWER SUPPLIES

- A. Power supplies shall be as specified in Section 40 78 59.

2.6 INTERNAL WIRING

- A. See Section 40 67 33

2.7 SPARE PARTS

- A. Spare parts are to be provided in accordance with Section 40 61 13

PART 3 EXECUTION

3.1 TEST PLANS AND REPORT

- A. The Contractor shall be required to prepare and submit for review and approval the following:

1. Factory Acceptance Test Plan and procedures.
2. System Acceptance Test Plan and procedures.
3. Test Schedules.
4. Test Reports.
5. Instrument and (applicable) component calibration sheets.
6. Reference the City's Lift Station Control Package including the Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

3.2 FACTORY TESTING

- A. Factory Acceptance Test (FAT) and verification for all deliverable equipment, programs, and associated documentation shall be performed prior to shipment of the system. The tests shall verify that the equipment is manufactured and assembled correctly, is operating as designed, and is in compliance with the contractual requirements. The tests shall verify that the software and hardware meet the functional and performance requirements of the project. The FAT shall be performed at the Contractor's factory and shall be witnessed by Owner personnel.
- B. During the FAT, the facility integrator shall coordinate with Owner for completion of the Owner's Witness testing standard review forms. All items noted for change shall be completed prior to delivery to site for installation.
- C. The Contractor shall schedule the factory test at least 2 weeks ahead of factory test date with approval of City.

3.3 INSTALLATION

- A. Mount and shim to precise alignment floor mounted control panels so doors operate without binding. Provide sealant for conduit entering the panels.
 1. Anchor panels in a manner to prevent the enclosure from racking, which may cause the access doors to become misaligned.
- B. Floor-mounted panels shall be mounted on feet kits as shown on the drawings.
- C. Provide panels with the laminated Record As-built schematic, connection, and interconnection diagrams placed in a water proof clear bag in the panel document holder.
- D. Vacuum clean control panels and cabinets.

3.4 SYSTEM TEST

- A. PROCEDURES: Section 40 61 21.
- B. The following testing is in addition to Section 40 61 21 requirements for the preoperational test phase and component test phase.
- C. A System (pre-startup) Test, shall be performed at the site. The final documentation will then be reviewed for completeness. Testing shall be witnessed by City personnel.
- D. The System test shall include the requirements as follows:
 - 1. The test shall verify that the equipment and all cables have been properly installed, have not been damaged, and have not failed in shipment or storage
 - 2. The test shall demonstrate stable operation of all PLC I/O modules, wiring, and data transmission to the OIT under actual operating or simulated conditions. The test shall also demonstrate proper operation of all digital or sequential control. All start/stop, open/close, raise/lower and similar commands and all discrete status inputs shall be tested for proper operation. In addition, all alarms, both analog and discrete, shall be tested.
- E. During the System test, the Contractor and facility integrator shall coordinate with the Owner for completion of the Owner's Lift Station Pre-startup package standard review forms. All items noted for change shall be completed prior to System Acceptance Testing (startup).
- F. After one week of operation without notable events or failures, finalize the wiring between the new PLC, I/O and field devices. Organize unused wiring to provide a neat and clean appearance.

END OF SECTION

SECTION 40 67 33

PANEL WIRING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Installation
 - 6. Testing

1.2 SCOPE

- A. This section specifies wiring requirements for wiring of process control panels.
- B. Comply with the specified products in Sections 40 61 13 and 40 67 16. Panels that do not comply with the specified products and specified logic method, hardwired or PLC logic, shall not be accepted. Cost to retrofit the panel as specified shall be borne by the panel supplier. Corrections or modifications to UL 508A Industrial Control Panels shall be transported to the panel supplier's facility for corrections, testing, relabeling and inspection.
- C. All panel wiring is to be completed within a UL 508A certified fabrication facility. Field modifications require a UL inspector site inspection for approval of panel corrections and to re-label the panel after the field modifications are completed.
- D. Refer to Control Panels - Section 40 67 16 that specifies requirements for manufacturer, vendor, and Contractor provided panels that may include motor controllers, combination motor starters, control devices, and logic devices as shown on the electrical drawings. These requirements apply to this section as well.

1.3 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty workmanship for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

C. REFERENCE STANDARDS:

1. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued,

Reference	Title
NEMA 250	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous (Classified) Locations

D. LISTED PRODUCTS

1. Equipment and components to be Underwriters Laboratory (UL) listed for the purpose per Section 40 61 13 or UL recognized.
2. Provide factory applied UL 508A labels for control panels. Where intrinsic safety barriers are used within a control panel, provide UL 698A factory applied label as required by UL.

1.4 SUBMITTALS

A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the

Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Submittal items required include:
1. Wire Types
 2. Labeling materials and methods
 3. Wiring lugs
 4. Wireways
 5. Hinge wiring method description

PART 2 PRODUCTS

2.1 WIRE MARKERS

- A. Wire markers shall be printed heat shrink type as specified in Section 26 05 00.

PART 3 EXECUTION

3.1 INTERNAL PANEL WIRING

- A. Panel control wiring: 120V wiring that is not connected directly to a breaker, Single red conductor stranded copper NFPA No. 70 Type MTW/TEW No. 14 AWG minimum. Single white conductor stranded copper Type MTW/TEW No. 14 AWG for control neutral conductors.

- B. Breaker panel wiring: Single Black conductor stranded copper NFPA No. 70 Type MTW/TEW No. 12 AWG minimum for wiring to breakers in the breaker panel and single White 12 AWG minimum for neutral conductors used in the breaker panel.
- C. All 12VDC+ conductors shall be NFPA No. 70 Type MTW/TEW No. 16 AWG, orange. All 12VDC- conductors shall be NFPA No. 70 Type MTW/TEW No. 16 AWG, yellow.
- D. All 24VDC+ conductors shall be NFPA No. 70 Type MTW/TEW No. 16 AWG, dark blue. All 24VDC- conductors shall be NFPA No. 70 Type MTW/TEW No. 16 AWG, white with blue stripe.
- E. All intrinsically safe wires shall be purple.
- F. Panel instrument wiring/Analog inputs: Twisted No. 18 AWG shielded twisted pair. Connect the shield drain on the pump control panel end.
- G. Panel power wiring: Conductors specified in Division 26 and meet the NFPA No. 70 NEC requirements for power including phase, grounded, and grounding conductors.
- H. Arrange wiring neatly, cut to proper length, and remove surplus wire.
- I. No more than two connections made to one terminal point.
- J. Wiring shall be supported independently of terminations by lacing to panel support structure or by slotted flame-retardant plastic wiring channels.
- K. Power and control wiring carried in covered channels separate from low voltage signal circuits.
 - 1. Wiring channel fill not to exceed 40 percent per NFPA 70.
- L. Restrain by plastic ties or ducts or metal raceways.
- M. Provide abrasion protection for wire bundles that pass-through holes or across edges of sheet metal.
- N. Hinge Wiring: Secure at each end so bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
- O. Connections to Screw Type Terminals:
 - 1. Locking-fork-tongue or ring-tongue lugs.
 - 2. Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations.
 - 3. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.

4. Wires terminated in a crimp lug, maximum of one.
 5. Lugs installed on a screw terminal, maximum of two.
- P. Connections to Compression Clamp Type Terminals:
1. Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.
 2. Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two.
- Q. Plastic Wire Ducts Color:
1. 120V ac: White.
 2. 24V dc: Gray.
 3. Communications Cables and Fiber Optic Jumpers: Orange.
- R. Provide a minimum of 1-1/2 inches between plastic wire ducts and terminal blocks.
- S. Control Relay Arrangement: See contract drawings for layout.
- T. CONDUCTOR IDENTIFICATION:
1. Wiring colors shall be as listed above.
 2. Wire tag numbers shall be as shown on the contract drawings to the greatest extent possible. Additional wiring, if not shown with an identifier, shall use a short identifier with descriptive labeling similar to that shown on the contract drawings.
 3. Wire tag numbers to be machine printed on white sleeves with text 1/8 inches high minimum in permanent black machine printed ink.
 4. All wires shall be labeled with the same description on both ends and shall be oriented in the same direction. Horizontal wire to read from left to right and vertical wires to read from top to bottom.
- U. FIELD WIRING:
1. Field wiring shall be connected to separate dedicated terminal blocks in a dedicated part of the panel where the field cables enter the panel as shown on the contract drawings.
- V. PANEL GROUNDING
1. Provide each control panel with copper ground bars as shown on the contract drawings. See specification section 26 05 26 for additional information.

2. Provide grounding terminal for instrumentation shielding ground. All shielding for analog circuiting to be terminated at the pump control panel end.

3.2 TESTING

A. FACTORY TESTING:

1. Prior to shipment, the manufacturer tests the functional operation of the control panels as described in Section 40 67 16 and 40 61 21.
2. Complete point to point testing and verification of each wire.
3. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 40 71 13

MAGNETIC FLOW METERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Product Requirements
 - 7. Installation
 - 8. Testing
 - 9. Manufacturer's Services

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of the Magnetic Flow Meters measuring system(s). This includes testing, documenting, and start up.
- B. Contractor shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Instruments shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. UL – Underwriters Laboratory approved
- B. ASTM – American Society for Testing and Materials
- C. NEMA – National Electrical Manufacturer's Association
- D. NEC – National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
 - 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided.
 - 1) Must include:
 - a) Dimensional Drawings
 - b) Materials of Construction
 - (1) Sensor

- (2) Liner
- (3) Electrodes
- (4) Process Connection

- 2) Accuracy
- 3) Range
- 4) Enclosure Rating
- 5) Classification Rating
- 6) Power Requirements
- 7) Output Options

- D. Manufacturer's installation instructions, including mounting requirements.
- E. Operation and maintenance information.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13.
- B. OPERATING CONDITIONS: Section 40 06 70 instrument schedules.
- C. This section specifies requirements for supply and installation of Magnetic Flow Meters listed in Section 40 06 70 Schedules of Instrumentation for Process Systems.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. To maintain existing City's standards and ease of replacement and maintenance, the flowmeter shall be a Siemens Sitrans FM MAG 5100W flow sensor with a MAG 6000 remote mounted transmitter.

2.2 GENERAL

- A. Magnetic flow meter provided as a system consisting of a flow tube with locally or remotely mounted converter / indicating transmitter as listed in the instrument schedule or as shown on the drawings. Meters to be provided with all required interconnecting cables between flow tube and transmitter.

2.3 FEATURES

A. Flow Tube:

1. The flow meter shall be microprocessor based and possess a method in which to store the sensor calibration and transmitter setup information in non-volatile memory. The electronics shall be interchangeable for meters sizes 1" – 80"
2. The sensor shall consist of a stainless-steel flow tube with ANSI B16.5 or AWWA C207 carbon steel flanges. The flanges shall carry Class 150 or 300 for 24" and smaller, and AWWA Class D for 28" and larger as specified.
3. The sensor tube shall be NBR rubber lined.
4. The sensor shall house two measuring electrodes, a grounding electrode, and one for measurement including empty pipe detection. The electrodes shall be made of hastelloy.
5. The full-bore magnetic flowmeter in sizes 1"-80" shall maintain zero pressure loss while achieving 0.5% of rate accuracy even when mounted directly before or after a piping elbow, T-fitting or insertion device.
6. The external sensor housing shall enclose the coil assemblies and internal wiring. The materials shall be designed and constructed to prevent moisture ingress and promote corrosion resistance.
7. Process Connection: Flange, ANSI B16.5, Class 150, raised face.
8. Flow tubes shall be pressure rated from full vacuum to 300 psig, unless otherwise noted.
9. Grounding Ring required and must be provided with flow meter.
10. The sensor shall be rated for NEMA 6P/IP68 service and shall allow for permanent immersion in water depths up to 10 feet when used outdoors with an indoor remote mounted transmitter.
11. Provide electrode cable for use with empty pipe detection.
12. Materials:
 - a. Flow Tube: 316 L stainless steel
 - b. Flange: Carbon Steel
 - c. Electrodes: Hastelloy

- d. Grounding Rings: Same metal as for the electrodes
- e. Liner: Hard rubber - NBR

B. Indicating Transmitter:

1. The transmitter shall be a three-stage microprocessor controller wall-mounted remotely for outside sensor location or compact design (attached to sensor) for interior locations. The transmitter shall operate on AC (100 to 240V) or DC (24 V) via a dedicated or universal power supply as specified. The transmitter housing will carry a NEMA 4X rating and shall be constructed to prevent moisture ingress, promote corrosion resistance, and be impervious to saline environments.
2. The measurement signals from the sensor shall be conducted up to 1,968 feet to the transmitter.
3. The transmitter display shall indicate simultaneous flow rate and total flow with three Totalizers (eg. forward, reverse and net total) and user-selectable engineering units, readout of diagnostic remedy messages.
4. 4-20 MA output proportioned to flow range.
5. The transmitter shall internally retain all setup parameters, calibration parameters and accumulated measurements in non-volatile memory in the event of power failure.
6. Pulse output selectable for gallons per pulse, mass per pulse, or maximum frequency for 100% flow.
7. Internal circuitry to drive flow signal to zero upon flow meter determined empty pipe condition.
8. Provide wall mounted transmitter for remote unit at main control cabinet for flowmeter located in vault.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13.
- B. Install all components of Magnetic Flow Meters system in accordance with manufacturer's specifications and instructions for the specified functional requirements.

- C. Ensure proper installation of the Magnetic Flow Meters system so as to not result in false reading due to ambient conditions or equipment at the installation site.
- D. Verify installation of grounding rings and ground connection with manufacturer's requirements.
- E. After testing, use potting material per manufacturer's requirements for sealing flowmeter terminal connection box water-proof.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Instruments shall be calibrated and tested on site in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- C. In addition, the instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed system.
- D. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13 and 40 61 21.
- B. Contractor shall provide the services of the manufacturer's representative for a minimum of one day to evaluate the installation of the instruments, testing and calibration, certification of proper installation, and training.

END OF SECTION

SECTION 40 71 77

CHECK VALVE LIMIT SWITCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Products Requirements
 - 6. Installation
 - 7. Testing
 - 8. Manufacturer's Services

1.2 SCOPE

- A. This section specifies requirements for supply and installation of Check Valve Limit Switches listed in Section 40 06 70 Schedules of Instrumentation for Process Systems.

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer's Association
- C. NEC – National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided. Edit to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
- D. Manufacturer's installation instructions.
- E. Operation and Maintenance Manual if applicable.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13.
- B. OPERATING CONDITIONS: Section 40 06 70 instrument schedules.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Check Valve Limit Switch candidate manufacturers and models:

1. Receptacle - Eaton E50RA
2. Switch body - E50SA.
3. 5° head – E50DR1
4. Lever Arm – E50KL537

2.2 GENERAL

- #### A. Heavy duty mechanical type modular limit switch
- #### B. Include receptacle, switch body, 5° head and roller lever arm for a complete operational unit.

2.3 FEATURES

1. Heavy duty plug-in style.
2. Operating temperature: 10° - 200° F
3. Side rotary actuator, spring return with clockwise or counterclockwise operation.
4. Switch Gasket Material: Viton
5. Material of Construction: Zinc die cast
6. Environmental Rating: NEMA 4X and 6P.

2.4 ELECTRICAL REQUIREMENTS

1. Contact Configuration: 1 Normally open and 1 Normally closed.
2. Contact Material: Fine silver.
3. Maximum Contact Rating: 10A at 120 Vac, 1A at 250 Vdc.
4. Electrical life: 1,000,000 operations typical at full load.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Install all components of the check valve in accordance with manufactures specifications and instructions.
- C. Instruments shall be installed, calibrated and tested on site in accordance with the requirements of Section 40 61 13 and 40 61 21 and in accordance with the manufacturer's recommendations.
- D. Unit shall be installed using custom bracketing as shown on the drawings. Switch and bracket shall be adjusted as required for complete operation.
- E. The instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed system.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Ensure proper installation of the check valve limit switch and verify adjustment with check valve for proper flow actuation.
- C. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 40 72 13

ULTRASONIC LEVEL METERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Product Requirements
 - 7. Installation
 - 8. Testing
 - 9. Manufacturer's Services

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of the Ultrasonic level measuring system(s). This includes testing, documenting, and start up.
- B. Contractor shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Instruments shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. UL – Underwriters Laboratory approved
- B. ASTM – American Society for Testing and Materials
- C. NEMA – National Electrical Manufacturer's Association
- D. NEC – National Electrical Code
- E. NFPA No. 70, NEC - National Electrical Code
- F. NFPA No. 79, Electrical Standard for Industrial Machinery.
- G. ISA – Instrumentation, Systems, and Automation Society.

- H. ICS-1 – General Standards for Industrial Control and System
- I. ICS-2 – Standards for Industrial Control Devices, Controllers and
- J. ICS-3 – Industrial Systems.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

- C. Product Data: For each type of device and system:
 - 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- D. Manufacturer's installation instructions, including mounting requirements.
- E. Operation and maintenance information.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13
- B. OPERATING CONDITIONS: Section 40 06 70 instrument schedules.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. To maintain existing City's standards and ease of replacements and maintenance, the Ultrasonic Level Measurement System shall be a Siemens LUT420 with an Echomax XPS-15 (6° beam angle) sensor.

2.2 GENERAL

- A. Ultrasonic Level Measurement provided as a system consisting of a level transmitter and a remotely mounted converter / indicating transmitter unless otherwise noted. Units to be provided with all required interconnecting cables.
- B. Transmitter specified is to comply with Section 40 61 13 transmitter requirements.

2.3 FEATURES

- A. Process Connection shall be a dedicated mounting bracket.
- B. The transmitter shall have a multi-field backlit LCD display with individual alarm status lights and meet the following requirements:
 - 1. Calibration and programming of the transmitter shall be menu driven via a four button keypad on the controller or with a PC through USB using the integrated Web browser tool.

2. The resolution shall be 0.1% of program range or 2mm, whichever is greater
 3. Auto False-Echo Suppression to avoid false echoes from fixed obstructions.
 4. Wall mount the transmitter interior to the building as shown on the drawings.
 5. Basic data logging capability downloadable to a PC through USB using the integrated Web browser tool.
 6. Level or Volume measurement with basic pump control functions.
- C. The transducer operating principle shall be based on acoustic impulses emitted from an Ultrasonic transducer reflecting back from the material surface. The transit time of pulse travel from generation to echo is measured. The elapsed time is proportional to the distance between the transducer face and material surface.

The primary sensor shall be an acoustic transducer containing a polarized Zirconium crystal with acoustic impedance matching face and transformer and shall meet the following requirements:

1. The transducer housings shall be Kynar.
2. The Accuracy shall be +/- 0.25% of range or 6mm; whichever is greater.

2.4 ELECTRICAL REQUIREMENTS

- A. Transmitter and transducer for the Ultrasonic level measurement system shall meet/provide following standards/requirements:
1. The transmitter power supply shall be 120 VAC, 60Hz. Transducer power shall only be supplied by a Siemens certified controller.
 2. Ambient operating temperature of -5F to 122F.
 3. The transmitter shall have a minimum of (3) relay and (1) isolated 4- 20mA outputs.
 4. Transmitter: 4 to 20 mA dc output signal rated for 500-ohm load.
 - a. Outputs shall be scalable and assignable to measure distance to product being measured or depth/level or product/liquid being measured.
 5. Signal cable between the transducer and the transmitters shall be provided by the system manufacturer with sufficient length of cable for continuous installation between the two components.
 6. Transducer to be FM approved for Class I & II, Div. 1 Groups A, B, C & D; Class II, Div. 1, Groups E, F, & G.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13.
- B. Install all components of Ultrasonic level measuring system in accordance with manufacturer's specifications and instructions for the specified functional requirements.
- C. Ensure proper installation of the Ultrasonic level measuring system so as to not result in false reading due to ambient conditions or equipment at the installation site.
- D. Mount transmitter inside of Main control cabinet or as shown on the drawings.
- E. Mount sensor inside of wet well as shown on the drawings.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Instruments shall be calibrated and tested on site in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- C. In addition, the instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed system.
- D. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13 and 40 61 21.
- B. Contractor shall provide the services of the manufacturer's representative for a minimum of one day to evaluate the installation of the instruments, testing and calibration, certification of proper installation, and training.

END OF SECTION

SECTION 40 72 76

LEVEL SWITCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Product Requirements
 - 6. Installation
 - 7. Testing

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of wetwell high level sensing device as shown on the contract drawings.

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer’s Association
- C. NEC – National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or

deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
 3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.
- C. Manufacturer's installation instructions.
- D. Operation and Maintenance Manual if applicable.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Level Switches (See drawings for specific model)
 - 1. Roto-Float
- B. Mounting Bracket (See drawings for specific model)
 - 1. Anchor Scientific

2.2 GENERAL

- A. Float switches shall be provided where indicated, specified, or required to meet the functional requirements of the System, as specified.
- B. Unit shall be suspended type, and provided with length of cable required to reach Isolation pedestal panel without splicing. Contractor to verify length of cable required for float switch before ordering.
- C. Float switches shall be provided with necessary brackets and clamps to suspend the unit as shown on the contract drawings. The suspended type shall include an integral weight assembly for stabilization and positive operation of the unit.

2.3 FEATURES

- A. Direct-acting float type consisting of a mechanically activated (mercury) SPST switch enclosed in a float and connected to a multi-conductor combination support and signal cable. The entire assembly shall form a completely watertight and impact-resistant unit.
- B. Chemical-resistant polypropylene or other corrosion-resistant float material suitable for use in water and wastewater applications.
- C. Cable shall be rugged and flexible with heavy neoprene or PVC jacket.
- D. The suspended type shall include an integral weight assembly for stabilization and positive operation of the unit.
- E. Actuation/deactivation differential shall be 1 inch minimum.

2.4 ELECTRICAL REQUIREMENTS

- A. Switch shall be SPST, Normally Open, rated at 4.5 amps (minimum) at 120 VAC.
- B. The cable shall be UL listed PVC Type STO with 18 AWG, 600V rated conductors.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install all components in accordance with manufactures specifications and instructions.
- B. Install float switch as shown on the contract drawings.

3.2 TESTING

- A. Ensure proper actuation of the level switch by tilting of the float between its activation and de-activation points.
- B. Verify control circuit engages upon float actuation and system operates appropriately.
- C. Reference the Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 40 73 26

GAUGE PRESSURE TRANSMITTERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Products Requirements
 - 7. Installation
 - 8. Testing
 - 9. Manufacturer's Services

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of Gauge Pressure and measuring system(s). This includes testing, documenting, and start up.
- B. Contractor shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Instruments shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer's Association
- C. NEC – National Electrical Code
- D. NFPA No. 70, NEC - National Electrical Code
- E. NFPA No. 79, Electrical Standard for Industrial Machinery.
- F. ICS-1 – General Standards for Industrial Control and System
- G. ICS-2 – Standards for Industrial Control Devices, Controllers and

- H. ICS-3 – Industrial Systems.
- I. UL – Underwriter’s Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:

1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided. Edit to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
- D. Manufacturer's installation instructions, including mounting requirements.
- E. Operation and maintenance information.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13
- B. OPERATING CONDITIONS: As specified herein and on the drawings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Pressure Transmitter candidate manufacturers and models:
 1. Siemens P-320 series (See drawings for specific models)

2.2 GENERAL

- A. Pressure measurement provided as a system consisting of a pressure transmitter with integral process connection and local display with glass panel.
- B. Transmitter specified is to comply with Section 40 61 13 transmitter requirements.
- C. Provide all parts, materials, fluids, etc. necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.
- D. Provide diaphragm seal for preventing medium from entering into the pressure sensing assembly.

2.3 FEATURES

- A. Process Connection: Male thread ½" NPT.
- B. Maximum measuring span: 16 bar (232 psi).

- C. Silicon oil measuring cell filling.
- D. System error shall not exceed $\pm 0.25\%$ of range
- E. Combined non-linearity, hysteresis, and repeatability accuracy of 0.05% of full scale.
- F. Temperature Range: -40 to 85 °C (Operating), 0 to 50°C (Compensated).
- G. Transmitter Materials:
 - 1. Wetted parts: 316 stainless steel.
 - 2. Non-wetted parts: Die-cast aluminum

2.4 ELECTRICAL REQUIREMENTS

- A. Input current: 20 mA max (loop Power)
- B. Signal Output: 4-20mA Analog signal. Signal shall change in direct linear proportional to changes in measured value.
- C. Intrinsically safe model.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13.
- B. Install all components of pressure measuring system in accordance with manufacturer's specifications and instructions for the specified functional requirements.
- C. Comply with mounting details provided on the drawings.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Instruments shall be calibrated and tested on site in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer.

- C. In addition, the instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed system.
- D. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13
- B. Contractor shall provide the services of the manufacturer's representative for a minimum of one day to evaluate the installation of the instruments, testing and calibration, certification of proper installation, and training.

END OF SECTION

SECTION 40 78 19

SWITCHES, PUSHBUTTONS, AND INDICATING LIGHTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope
 2. Reference Standards
 3. Quality Assurance
 4. Submittals
 5. Product Requirements
 6. Installation
 7. Testing

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of indicating lights, selector switches, pushbuttons and other pilot devices.

1.3 REFERENCE STANDARDS

Reference	Title
ASTM	American Society for Testing and Materials
NEMA	National Electrical Manufacturer's Association
NEC	National Electrical Code
NFPA No. 70, NEC	National Electrical Code
NFPA No. 79	Electrical Standard for Industrial Machinery
ISA	Instrumentation, Systems, and Automation Society
ICS-1	General Standards for Industrial Control and System
ICS-2, ICS-3	Standards for Industrial Control Devices, Controllers and Industrial Systems
UL	Underwriter's Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)
Standard 508	Industrial Control Panels for General Use
Standard 698	Industrial Control Panels Relating to Hazardous (Classified) Locations
Standard 913	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations
NETA	National Electrical Testing Association

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 67 16 Control Panels and 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
 - 1. Include product data sheets and equipment brochures showing standard products and specified accessories.

- a. Mark data sheets to clearly show exact product and options being provided. Edit to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
- D. Manufacturer's installation instructions.
- E. Operation and Maintenance Manual if applicable.
- F. Warranty information.

PART 2 PRODUCTS

2.1 GENERAL

- A. Pilot Devices shall be provided as a Panel Assembly component where indicated, specified, or required to perform the functional requirements of the System, as specified. All Pilot Devices shall meet the following minimum specifications, unless otherwise noted.
- B. Control panel pilot devices:
 - 1. All pilot devices shall be of heavy-duty, plastic, type 1, 4X, 12&13, watertight/oiltight construction. Units shall mount through a 22 mm round hole.
 - 2. All pilot devices shall have custom legends as shown. Legends shall be black with white letters, and letter height shall be minimum 5/32-inch-high characters.
 - 3. All button and lens colors shall be as shown. Color code is as follows:
 - a. B = Blue, R = Red
 - 4. All pilot devices shall be equipped with a sufficient number of contact blocks to accomplish the switching functions specified.
 - 5. Indicating lights shall meet the following minimum specifications, unless otherwise noted.
 - a. All indicating lights shall be full voltage type with LED lamps. Units shall be rated for the voltage shown.
 - b. All indicating lights shall be wired "push-to-test" type via a normally closed contact attached to the operator.
 - c. All indicating light lenses shall be plastic.
 - 6. All selector switches shall be knob type.

7. Illuminated push buttons shall be full voltage type with LED lamps.
8. To match existing Owner standard for operation and maintenance and spare parts, the indicating lights for the Pump control panel shall be IDEC HW Series.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Install per manufacturer's instructions.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Ensure proper installation per manufacturers recommendations
- C. Devices shall be operationally tested in conjunction with the systems acceptance test of the complete system of Instrumentation and Controls for the completed system.
- D. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 40 78 53

RELAYS AND TERMINAL BLOCKS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Quality Assurance.
 - 3. Reference Standards
 - 4. Submittals.
 - 5. Performance Requirements.
 - 6. Products.
 - 7. Installation.
 - 8. Testing.

1.2 SCOPE

- A. This section specifies requirements for Auxiliary Relays used for control signal isolation and Terminal Blocks used for control conductor termination installed in control panels.

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer’s Association
- C. NEC – National Electrical Code
- D. NFPA No. 70, NEC - National Electrical Code
- E. NFPA No. 79, Electrical Standard for Industrial Machinery.
- F. ICS-1 – General Standards for Industrial Control and System
- G. ICS-2 – Standards for Industrial Control Devices, Controllers and
- H. ICS-3 – Industrial Systems.
- I. UL – Underwriter’s Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)
 - 1. Standard 508 (Industrial Control Panels for General Use).

2. Standard 698 (Industrial Control Panels Relating to Hazardous (Classified) Locations)
 3. Standard 913 (Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations)
- J. NETA – National Electrical Testing Association.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements,

with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

- C. Product Data: For each type of device and system:
 - 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided. Edit to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
- D. Manufacturer's installation instructions, including mounting requirements.
- E. Operation and maintenance information.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

A. RELAYS:

- 1. OPERATING CONDITIONS: Environmental and Hazardous Location ratings shall be determined by the ratings of the control apparatus for the installation where used. Where Relay does not meet these requirements, a suitable enclosure shall be provided to meet the requirements.
- 2. Relays shall be provided with the appropriate number of contacts to accommodate the specified functions as shown on the drawings. At a minimum, relays shall be double pull double throw form "C" type.
- 3. All relays are to be provided with Din-rail mountable bases when available.

B. TERMINAL BLOCKS:

- 1. OPERATING CONDITIONS: Environmental and Hazardous Location ratings shall be determined by the ratings of the control apparatus for the installation where used. Where Terminal block does not meet these requirements, a suitable enclosure must be provided that meets the requirements.
- 2. Terminal block shall be rated for the Voltage, Amperage, and Conductor size for the application requirements.

PART 2 PRODUCTS

2.1 RELAY CANDIDATE MANUFACTURERS

- A. Power or Phase Monitor Relays
 - 1. Eaton, D65VMLP480
- B. Plug-in Interposing/Auxiliary Relays
 - 1. Idec RH Series
- C. One-shot (pulse) Relay
 - 1. Allen Bradley, 700-HLS1Z24
- D. Timing Relays for Auxiliary Control
 - 1. Crouzet OU1R10MV1
- E. Submersible Pump Thermal/Leakage Relay
 - 1. Flygt Din-Rail mountable MiniCAS II

2.2 RELAYS GENERAL

- A. Relay contact ratings shall be evaluated for rated Voltage and Amperage per application needs to obtain minimum operational cycles:
 - 1. Power and Master Control Relays
 - a. 10,000,000 mechanical operations and 100,000 electrical operations at rated load.
 - 2. Plug-in Interposing/Auxiliary Relays
 - a. 10,000,000 mechanical operations and 200,000 electrical operations at rated load.
 - 3. Timing Relays for Auxiliary Control
 - a. 10,000,000 mechanical operations and 100,000 electrical operations at rated load.
 - 4. Submersible Pump Thermal/Leakage Relay

- a. 10,000,000 mechanical operations and 100,000 electrical operations at rated load.
- B. Plug-in Style Interposing/Auxiliary relays shall be equipped with an LED indicator light.
- C. Coil voltage shall match the control circuit voltage.

2.3 TERMINAL BLOCKS

A. GENERAL:

1. Terminal Blocks for all contractor supplied equipment and devices shall be manufactured by Sprecher Schuh, Allen Bradley, or Weidmuller.
 - a. Sprecher Schuh V7-W4 preferable.
2. Unless otherwise specified, terminal blocks shall be panhead strap screw type. Terminals shall be provided with integral marking strips which shall be permanently identified with the connecting wire numbers as shown on the drawings. Terminal blocks for P-circuits (power 120-600 volts) shall be rated not less than the conductor current rating and shall not be rated less than 600 volts AC. Terminal blocks for C-circuits (control and/or control power 120 volts or less) and S-circuits (signal) shall be rated not less than 20 amperes and shall not be rated less than 600 volts AC. Terminals shall be tin-plated. Insulating material shall be nylon.
3. Provide terminals for all wire connections to field wiring and internal power distribution.
4. Connections shall have screw terminals capable of terminating 2 #10 AWG stranded wires. Terminals shall be DIN rail strip mounted. Provide number strips for terminal blocks that are referenced by the wire marker. Provide bridge bars for jumpering between terminal blocks. Provide end clamps to separate and terminate terminal block groups. Provide end covers for groups of terminal blocks in sets to match the number points associated with individual I/O cards in the PLC block.
5. Provide Separation Plates on each side of terminals that are at a different potential or polarity than surrounding terminals.
6. Terminals shall be mounted such that there is a minimum of 1.5 inches of clear space on both sides of the terminal; for ease of wiring.
7. Provide 10 spare terminals or 5% whichever is the greater amount, spare (non-installed) replacement terminals for each type used.
8. Provide wired terminals to match the number of points supplied for field termination on each installed I/O card or spare slot in a PLC cabinet.

B. FUSED TERMINALS:

1. AC fused terminal blocks shall be hinged disconnect level type with "blown fuse" neon indicators. Sprecher Schuh V7-H4 series.
2. DC fused terminal blocks shall be hinged disconnect level type with "blown fuse" LED indicators. Sprecher Schuh V7-H5 series.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions for the specified functional requirements.

3.2 TESTING

- A. Relays shall be tested in accordance with the requirements of the manufacturer's recommendations. Field calibration shall be conducted by the facilities integrator.
- B. Devices shall be operationally tested in conjunction with the systems acceptance test of the complete system of Instrumentation and Controls for the completed system.
- C. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 40 78 56

INTRINSICALLY-SAFE BARRIERS AND RELAYS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope
 2. Reference Standards
 3. Quality Assurance
 4. Submittals
 5. Product Requirements
 6. Installation
 7. Testing

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of intrinsically safe barriers and intrinsically safe relays.

1.3 REFERENCE STANDARDS

Reference	Title
ASTM	American Society for Testing and Materials
NEMA	National Electrical Manufacturer's Association
NEC	National Electrical Code
NFPA No. 70, NEC	National Electrical Code
NFPA No. 79	Electrical Standard for Industrial Machinery
ISA	Instrumentation, Systems, and Automation Society
ICS-1	General Standards for Industrial Control and System
ICS-2, ICS-3	Standards for Industrial Control Devices, Controllers and Industrial Systems
UL	Underwriter's Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)
Standard 508	Industrial Control Panels for General Use
Standard 698	Industrial Control Panels Relating to Hazardous (Classified) Locations
Standard 913	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations
NETA	National Electrical Testing Association

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 67 16 Control Panels and 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
 - 1. Include product data sheets and equipment brochures showing standard products and specified accessories.

- a. Mark data sheets to clearly show exact product and options being provided. Edit to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.
- D. Manufacturer's installation instructions.
- E. Operation and Maintenance Manual if applicable.
- F. Warranty information.

PART 2 PRODUCTS

2.1 GENERAL

- A. Intrinsically safe devices (barriers/relays) shall be provided as a Panel Assembly component where indicated, specified, or required to perform the functional requirements of the System, as specified.
- B. All intrinsically safe devices shall be installed in accordance with applicable section of the NEC. Intrinsically safe wiring shall be separated from non-intrinsically safe wiring by at least 2-inches or by other means acceptable per the NEC. Intrinsically safe wiring must be identified, with color coding, with purple conductors, and by tagging, at regular intervals, up to 25 feet. Non-intrinsically safe wiring shall not be connected to intrinsically safe terminations of intrinsically safe devices.

2.2 INTRINSICALLY SAFE RELAYS

- A. Intrinsically safe relays shall be fixed sensitivity type U/L approved for use with a remote pilot device (dry contact) located in Hazardous (Classified) areas.
 - 1. Provide and install intrinsically safe barriers/relays acceptable for use in Class I, Division 1, Group C or D, as required or indicated.
 - a. Designed and approved for use with discrete inputs.
 - b. Supply power: 20 to 125 VDC.
 - c. Output to track input.
 - d. LED in the cover to indicate the status of the input.
 - e. Selector switch to change the logic of the input.
 - f. Inputs: (2) channel Dry contact and or NAMUR.
 - g. Outputs: (1) SPST relay for each channel.

- B. To maintain existing City's standards and ease of replacements and the Intrinsically safe relays shall be a Turck IM1-22EX-R.

2.3 INTRINSICALLY SAFE BARRIERS:

A. Transformer isolated barrier

1. Containing a transformer to provide:

- a. Complete isolation between safe and hazardous areas for loop powered devices.
- b. 3-way isolation between safe area, hazardous area and power supply powered devices.
- c. Resistor for current limitation.
- d. Fuses for short circuit protection.
- e. Provide barriers with pluggable connectors that are coded for easy replacement.
- f. Transmission error shall be less than or equal to 0.1 percent of full scale.
- g. DIN rail mounted on 35 millimeters DIN rail
- h. Approvals:
 - 1) FM.
 - 2) UL 913

B. Intrinsically safe barriers shall conform to UL-913 or FM-3610 standards as approved by ETL, FM, MSHA, or UL Features

- 1. Provide and install intrinsically safe barriers/relays acceptable for use in Class I, Division 2, Group D, as required or indicated.
- 2. Intrinsically safe barriers shall meet the following minimum specifications, unless otherwise noted.
 - a. Barrier designed to be used with 4-20 ma DC signals.
 - b. Solid State construction
 - c. DIN rail mounted with removable terminal blocks.

- d. FM approved
- 3. Transmitter and converters for use with 4 to 20 milliamperes signals without Hart® communications capability:
 - a. Designed and approved for use with 4 to 20 milliamperes analog signals.
 - b. Designed for powering 2 and/or 3 wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
 - c. Supply voltage: 20 to 30 VDC with green LED for operational readiness.
- C. Unit to be a Turck IM31-11EX-I or as approved.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Install per manufacturer's instructions.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Ensure proper installation per manufacturers recommendations
- C. Devices shall be operationally tested in conjunction with the systems acceptance test of the complete system of Instrumentation and Controls for the completed system.
- D. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 40 78 59 – POWER SUPPLIES AND LINE CONDITIONERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope
 2. Reference Standards
 3. Quality Assurance
 4. Submittals
 5. Performance Requirements
 6. Products Requirements
 7. Installation
 8. Testing

1.2 SCOPE

- A. This section specifies requirements for Panel mounted 120 Vac input, 120 Vac and 24 Vdc outputs are specified herein or shown on the drawings.
- B. Comply with the specified products in Sections 40 67 16, 40 67 19, 40 78 00 and 40 67 63. Panels that do not comply with the specified products and specified logic method, hardwired or PLC logic, shall not be accepted. Cost to retrofit the panel as specified shall be borne by the panel supplier. Corrections or modifications to UL 508A Industrial Control Panels shall be transported to the panel supplier's facility for corrections, testing, relabeling and inspection.
- C. Field modifications require a UL inspector site inspection for approval of panel corrections and to re-label the panel after the field modifications are completed.
- D. Refer to Control Panels - Section 26 27 16 that specifies requirements for manufacturer, vendor, and Contractor provided panels that include motor controllers, combination motor starters, control devices, and logic devices as shown on the electrical drawings. These requirements apply to this section as well.
- E. Submittal drawing requirements specified in Section 40 61 13.
- F. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials

1.3 REFERENCE STANDARDS:

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NEMA 250	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous (Classified) Locations

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions

1.5 SUBMITTALS

- A. PROCEDURES: Submittals to comply with requirements of the City of Lacey Section D: Special Provisions and as specified herein.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be

provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply
 - c. Submittals are to be made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.
 4. Installation instructions, outline dimensions and weights including filters and/or phase shifting autotransformers, front view drawing identifying control and monitoring devices, nameplate engravings, shipping section dimensions, weight, and foundation requirements or wall mounting requirements for all assemblies.
 5. External connection diagram showing function and identification of all terminals requiring field connections.
 6. O&M manuals per Section 26 05 00 and shall comply with requirements of the City of Lacey Section D: Special Provisions.
- C. Submittal items required include:
1. Connection Diagrams.
 2. Power supply calculations.
 3. Product Data: For each type of device and system:

4. Include product data sheets and equipment brochures showing standard products and specified accessories.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 67 63.
- B. OPERATING CONDITIONS: Section 40 67 63.

PART 2 PRODUCTS

2.1 DIRECT-CURRENT POWER SUPPLIES

- A. Convert 120 VAC to 24-volt DC or other DC voltages required or as required for the application.
- B. Sized to provide 40 percent excess rated capacity.
- C. Sized as shown on the drawings as a minimum. Provide calculations to show anticipated load does not exceed 70% of power supply rating.
- D. UL 508C listed to allow full rated output without de-rating.
- E. FEATURES:
 1. Convection-cooled switching type.
 2. Line regulation: 0.4 percent for line variations from 85 to 132 volts.
 3. Output regulation: Static 0.05 percent, dynamic +2 percent overall.
 4. Ripple and noise: Not exceed 50 mV peak-to-peak.
 5. Continuous duty from 0 to 50 degrees C at rated load.
 6. Provide a minimum of 1 set of dry contacts configured to change state on failure for monitoring and signaling purposes.
 7. Continuous operation at overload/short-circuit: up to 1.5X nominal current continuous.
 8. Continuous protection against short-circuit, overload and open-circuit.
 9. Output voltage:
 - a. Rated 24 - 28 Vdc.
 - b. Adjustable plus or minus 5 percent.
 - c. Set to provide 24.0 volts.

- F. To match existing Owner standard for operation and maintenance and spare parts, the line power conditioner shall be a Sola SDP4-24-100LT.

2.2 LINE POWER CONDITIONER

A. Control panel power:

1. 120-volt control power source: Non-UPS powered:

a. Provide surge protection device (SPD) for panel power entrances:

- 1) Nominal 120 VAC, 5A, with a MCOV of 150 VAC
- 2) VPR L/N of 400 VAC, L/G 600 VAC and N/G 600 VAC.
- 3) Non-faulting and non-interrupting design.
- 4) A response time of not more than 5 nanoseconds.

b. Control panel power system level protection, non-UPS powered:

- 1) Design to withstand a maximum 10 kA test current of a 8/20 μ s waveform according to IEEE C62.41.1 Category B Area.
- 2) For panels receiving power at 120 VAC, provide surge protection at secondary of main circuit breaker.
- 3) Provide both normal mode noise protection (line to neutral) and common mode (neutral to ground) surge protection.
- 4) DIN rail mounting.
- 5) Attach wiring to the SPD by means of a screw type cable-clamping terminal block.
- 6) Single LED visual status indication of MOV integrity.
- 7) Dry contact rated for at least 250 VAC, 10 Amp for remote status indication.
- 8) Safety approvals:
 - (1) UL 1283 (EMI/RFI Filter).
 - (2) UL 1449 2nd Edition.

- B. To match existing Owner standard for operation and maintenance and spare parts, the line power conditioner shall be an Allen-Bradley 4983-DC120-05.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and Install in accordance with manufacturer's instructions for the specified functional requirements.

3.2 TESTING

- A. Power Supplies shall be tested in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations.
- B. Devices shall be operationally tested in conjunction with the systems acceptance test of the complete system of Instrumentation and Controls for the completed system.
- C. Reference the City's Pre-startup and Startup electrical checklist and associated instrument forms, included in Appendix.

END OF SECTION

SECTION 43 21 00

PUMPS, GENERAL

PART 1 GENERAL

1.1 SUMMARY

- A. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated.
- B. Where two or more pump systems of the same type or size are required, the pumps shall all be produced by the same manufacturer.
- C. Contractor shall provide all labor, equipment and materials and perform all operations in connection with the installation and testing of pumps. This work shall also include all assistance for installation, start-up and testing services to be provided by the Pump Supplier.
- D. All work performed under this section shall be in accordance with all approved trade practices and manufacturer's recommendations.
- E. Related Specification Sections include, but are not necessarily limited to:
 - 1. Section D – Special Provisions

1.2 SUBMITTALS

- A. Submittals shall be furnished in accordance with Section D 1-06.
- B. Shop Drawings shall contain the following information:
 - 1. Pump name, identification number and specification Section number.
 - 2. Performance data curves showing head, capacity, horsepower demand, NPSH required and pump efficiency over the entire operating range of the pump. The pump manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions.
 - 3. The limits on the performance curves recommended for stable operation without surge, cavitation or excessive vibration.
 - 4. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.
- C. Complete motor nameplate data as defined by NEMA, motor manufacturer and any motor modifications.
- D. Operation and Maintenance Manual containing the required information for each pump section.
- E. A spare parts list containing the required information for each pump section.

- F. Signed, dated and certified factory test data for each pump system which requires factory testing submitted before shipment of equipment.
- G. Certifications
 - 1. Manufacturer's written certification of proper installation
 - 2. Contractor's written certification of satisfactory field testing

PART 2 PRODUCTS

2.1 GENERAL

- A. Materials and equipment shall be standard products of a manufacturer and distributor regularly engaged in the manufacture and distribution of such products for at least two (2) years and shall be suitable for the service intended (pumping of unscreened, raw sewage). All materials and equipment shall be new and unused except for the testing specified herein.
- B. Compliance with the requirements of the individual pump sections may necessitate modifications to the manufacturer's standard equipment.
- C. All centrifugal pumps shall have a continuously rising performance curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or encroach on the service factor.
- D. All components of each pump system provided under the pump sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings and appurtenances.
- E. The pumps shall be supplied by a distributor authorized to service them throughout the warranty period and beyond. The distributor shall be located within a 100-mile radius of the site.
- F. The pumps shall be warranted by the manufacturer for a minimum of two (2) years from the date of final acceptance.

2.2 MATERIALS

- A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:
 - 1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A48 - Gray Iron Casings, Class 30, or equal.
 - 2. Stainless steel pump shafts shall be Type 416 or 316. Miscellaneous stainless steel shall be of Type 316, except in a septic environment.
 - 3. All anchor bolts, washers, and nuts shall be Type 316 stainless steel.

2.3 PUMP COMPONENTS, GENERAL

- A. Flanges -- Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 12, 125, 250, and 800 or B16.5 - Flanges and Flanged Fittings dimensions.

2.4 PUMP APPURTENANCES

- A. Nameplates -- Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed and Manufacturer's name and model number.

2.5 FACTORY TESTING

The following tests shall be conducted on each indicated pump system:

- A. Pump Systems -- All submersible pump systems shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests (ANSI/HI 1.6), the American National Standard for Vertical Pump Tests (ANSI/HI 2.6), or the American National Standard for Submersible Pump Tests (ANSI/HI 11.6) as approved by ANSI and published by the Hydraulic Institute. Tests shall be performed using the complete pump system to be furnished, including the motor. The following minimum test data shall be submitted:
 1. Hydrostatic test data.
 2. Performance test data, including a minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.
 3. Pump test curves showing head, flowrate, bhp, and efficiency. Acceptance level shall be Grade 1B as defined by HI.
 4. Leakage test results.
 5. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve.
 6. Certification statement that no critical speeds occur within the operational range of the pump.
- B. Acceptance -- In the event of failure of any pump to meet any of the requirements, the pump manufacturer shall make all necessary modifications, repairs or replacements to conform to the requirements of the Contract Documents and the pump shall be retested at no additional cost to the Owner until found satisfactory.

PART 3 EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. An authorized service representative of the manufacturer shall visit the project site to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted and readied for operation:
 - 1. Installation of the equipment
 - 2. Inspection, checking and adjusting the equipment
 - 3. Startup and field testing for proper operation
 - 4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements

3.2 INSTALLATION

- A. General -- Install and align pumps and fittings in accordance with the manufacturer's printed specifications and at the locations as shown on the Plans. Furnish and install anchor bolts recommended by the manufacturer. Place the pumps using equipment templates.
- B. Anchors for the unit shall be set in concrete, and the unit shall be mounted as instructed by the manufacturer. Anchors shall be drilled and set with epoxy. Contractor shall provide Engineer notice 24 hours in advance of installing base elbows, to allow for anchor bolt inspection. The manufacturer shall supervise installation to ensure that the unit is properly aligned and leveled, that all electrical and piping connections are properly made and that lubricants have been provided and installed.
- C. Alignment -- All equipment shall be field tested to verify proper alignment, operation as specified and freedom from binding, scraping, vibration, shaft runout or other defects. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.
- D. Lubricants -- The Contractor shall provide the necessary oil and grease for initial operation.

3.3 FIELD TESTS

- A. Each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, and cavitation or overheating of bearings.
- B. The following field testing shall be conducted:
 - 1. Startup, check and operate the pump system over its entire speed range. Where vibration analysis and measurement is required, it shall be within the amplitude limits specified and recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the Engineer.
 - 2. Obtain concurrent readings of motor voltage, amperage, pump suction head and pump discharge head for at least four pumping conditions at each pump rotational speed, including shut-off head. Check each power lead to the motor for proper current balance.

Obtain discharge pressure gauge readings and flow meter readings for each pumping condition. Record field test readings on City-approved form furnished by the Engineer. Acceptance testing shall include a comparison of measured installed flow and head, including shutoff head, with the manufacturer's curve value. Any discrepancy shall be resolved prior to acceptance by the Owner.

3. Submersible Pump Lift Test - Lift each submersible pump above the access hatch and then lower the pump back down onto the discharge elbow to demonstrate adequate clearances, smooth operation of the guide rail system, and proper re-seating of the pump on the discharge elbow.
 4. Electrical and instrumentation tests shall conform to the requirements of the Section under which that equipment is specified.
- C. Field testing will be witnessed by the Engineer. The Contractor shall furnish three days' advance notice of field testing.
- D. In the event any pumping system fails to meet the test requirements, it shall be modified and retested as above until it satisfies the requirements.
- E. After each pumping system has satisfied the requirements, the Contractor shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests and the test data.
- F. The Contractor shall bear all costs of field tests, including related services of the manufacturer's representative. If available, the Owner's operating personnel will provide assistance in field testing.

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SECTION 43 21 39

SUBMERSIBLE SEWAGE PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

Work covered in this Section includes furnishing, start-up, testing, and operation training for submersible sewage pumps as required for this project. Specified appurtenances, such as rails, brackets, discharge elbows, and control/power cables shall also be included. Like items of equipment specified herein shall be the end product of one manufacturer. Electrical controls and motor design requirements are specified in this section and the electrical section of these specifications. The Contractor shall be responsible for coordinating the pump requirements with the pump drive manufacturer and shall be responsible for the overall pump and drive performance.

1.2 SUBMITTALS

- A. Submittals during construction shall be made in accordance with Section D 1-06, and Section 43 21 00 Pumps, General.
- B. Submittals for Record - The pump supplier shall submit a manufacturer's installation and operation certificate and a statement that the equipment is suitable for the intended use.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

Pumps shall meet the requirements of Section 43 21 00, Pumps, General and the latest version of the Hydraulic Institute Standards for Submersible Pumps, except where modified herein.

1.4 FACTORY TESTING

Pump manufacturer shall provide factory tests in accordance with Section 43 21 00 Pumps, General. All test results shall be certified to be acceptable per the testing standards, and shall be submitted to and approved by Engineer prior to shipment of equipment.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. Identification:

Location	Lift Station No. 11
Pump Label(s)	Pump 1, Pump 2
Quantity	2

B. Power and Motor Requirements:

Voltage	208
Phase	3
Frequency	60 Hz
Motor Speed	3,400 rpm
Motor Horsepower	4
Efficiency Class	Standard Efficiency

C. Performance Requirements, One Pump Running:

Duty Point Minimum Flow Capacity	160 gpm
Duty Point Total Dynamic Head	57 feet
Static Head	46 feet
Shut-off Head Minimum	98 feet
Duty Point Minimum Pump Efficiency	60 %
Maximum NPSH required at Duty Point	18 feet

D. Operating Conditions:

Duty	Continuous
Drive	Direct On-Line
Ambient Environment	Wet Well - Corrosive
Ambient Temperature	33° - 104° F
Fluid Service	Municipal wastewater, raw and unscreened, containing rags, grit, fats, oil, and debris.
Fluid Temperature	50° - 90° F
Fluid pH Range	6.0 to 8.0
Fluid Specific Gravity	1.0
Net Positive Suction Head Available	33 feet

E. Solids Passing: Pumps shall all be capable of passing solids and fibrous material commonly found in raw wastewater. 3-inch solids passing is desired. However, if 3-inch solids passing is not available, manufacturer may alternatively offer a minimum 1-year no-clog guarantee that offers clear reimbursement for all costs associated with unclogging the pump, including staff time, as well as costs associated with damages resulting from a spill, if applicable.

F. Pumping System Dimensions:

Discharge Flange Rating (ANSI)	Class 125
Minimum Submersible Cable Length	As Required

G. Other Requirements

1. The head-capacity curve shall exhibit a uniformly rising characteristic from free discharge to shutoff. The pump motor shall be non-overloading throughout the entire pump curve.
2. The entire pump assembly shall be U.L. approved as Explosion Proof for operation in a Class 1, Division 1, Group D hazardous location.

2.2 PUMP CONSTRUCTION

- A. General - The pump shall be heavy-duty vertical, submersible with integral drive motor, single suction, centrifugal, sewage type, suitable for a permanent-type wet well installation.
- B. Pump – The pump shall be supplied with a mating cast iron discharge connection. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used. No portion of the pump shall bear directly on the sump floor. All exposed nuts or bolts shall be AISI type 316 stainless steel construction.
- C. Impeller - The impeller shall meet ASTM A-532 (Alloy III A) 25% chrome cast iron, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.
- D. Volute - The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing. The pump volute shall be coated with Metalclad Ceramalloy CP+AC manufactured by ENECON Corporation.
- E. Shaft - Pump and motor shaft shall be a solid continuous shaft. The pump shaft shall be an extension of the motor shaft. Couplings will not be acceptable. The pump shaft shall be stainless steel ASTM A479 S43100-T. The shaft shall be adequately designed to endure

alternating bending stresses and to provide for minimum overhang to reduce shaft deflection and prolong bearing life.

- F. Bearings -The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.
- G. Mechanical Seal - Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion and abrasion resistant tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating, corrosion and abrasion resistant tungsten-carbide seal ring.

Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

- H. Seal lubricant shall be FDA Approved, nontoxic.
- I. Cooling System-Motors shall be sufficiently cooled by the surrounding environment or pumped media without the need for a water jacket.
- J. Pump Discharge Elbow - The pump discharge connection shall be the elbow type. The discharge connection shall be bolted to the structure as recommended by the manufacturer and shall serve as a lower attachment for the guide rails, and as anchorage for the pump. The anchorage system shall be designed to transmit all forces safely to the structure, and may

incorporate intermediate supports as required. Calculations and supporting documentation justifying the support design may be requested, and shall be provided with the submittals. The design shall be non-sparking and shall conform to UL requirements for installation in a Class 1, Division 1, Group D hazardous location.

- K. Dual Rail Guide System - The pump shall be provided with a dual rail guide system to automatically and firmly connect the pump to the discharge piping when lowered into place on the discharge elbow. Once the pump has been positioned on its support fitting at the discharge elbow, the guide rail system shall not be required for pump support. The guide rail system shall allow easy removal of the pump without entering the wet well or disturbing the discharge piping. Single rail systems are not acceptable. All components of the guide system and pump anchorage shall be of stainless steel 316. Rails shall each be 2-inch diameter.
- L. Lifting Device – Pump shall not have a lifting cable or chain. Manufacturer shall replace the standard metal lifting strap with a 316 stainless steel strap secured with 316 stainless steel hardware that extends at least 12 inches from the top of the pump and sized/anchored to support the entire weight of the pump when lifted/lowered by the stainless steel strap.

2.3 MOTORS

- A. General - Each pump shall be provided with a vertically mounted standard efficient electric motor that conforms to the following requirements. Motors shall be designed to accept the total, unbalanced thrusts imposed by the pump. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and the pump shall be produced by the same manufacturer. The motor shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.
- B. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.
- C. Service Factors - The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be

designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

- D. Power Cable- The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices, approximately 20 feet in length. The power cable shall be of a shielded design in which an overall tinned copper shield is included and each individual phase conductor is shielded with an aluminum coated foil wrap. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.
- E. Cable Entry Seal - The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

2.4 PROTECTION

- A. Each motor stator shall incorporate three thermal switches, one per stator phases winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm.
- B. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.
- C. The thermal switches and float switch shall be connected to a monitoring system that shall be designed to be mounted in any control panel.
- D. Mini-CAS Relays: Each pump shall be protected by a solid-state relay to monitor motor winding temperature and seal leakage. The relays shall be wired to prevent motor operation when an alarm condition is present. The relays shall have an 11 pin octal base and shall be flanged for mounting on the inner door. The relay shall be powered by 24VAC, 28VDC or 120VAC supply. LED indicators shall be provided on the relay for power on, overtemp and seal fail conditions. An overtemp reset push button shall be mounted on the relay. The sensor input circuitry shall contain both hardware and software filters to provide noise immunity, as well as sensor input short circuit protection. The relay shall be Mini-CAS. Pump shall be shut down and alarm upon overtemp indication. Pump shall only alarm upon moisture indication.

2.5 SPARE PARTS

The following spare parts shall be provided:

- A. One set of mechanical seals.

- B. One set of O-rings.
- C. One set of wear rings.
- D. One spare impeller.
- E. One spare pump including a rebuild kit with power cord length matching installed pumps.

2.6 FABRICATED PUMP BASIN INSERT

- A. The pump manufacturer shall provide a pre-engineered hopper-shaped wet well FRP pump basin insert which is self-cleaning by virtue of its design. The flat surface area shall be minimized to an area that is directly influenced by the pump suction and shall be free of obstacles.

2.7 PUMP MANUFACTURER

Acceptable submersible sewage pump and fabricated pump basin insert manufacturer shall be Xylem Water Solutions. Acceptable model shall be Flygt NP-3085 SH Adaptive 255 with standard efficiency motor.

PART 3 EXECUTION

3.1 INSPECTION

Inspect pumps and fittings before installation to verify quality of material.

3.2 INSTALLATION

- A. Install and align pumps and fittings in accordance with the manufacturer's printed specifications and at the locations shown on the Plans. Use anchor bolts furnished or recommended by the manufacturer. Place the pumps using equipment templates.
- B. Anchors for the unit shall be set in the concrete, and the unit shall be mounted as instructed by the manufacturer. Anchors shall be drilled and set with epoxy. Contractor shall provide Engineer 24 hours notice prior to installing base elbows, to allow for anchor bolt inspection. The manufacturer shall supervise installation to ensure that the unit is properly aligned and leveled; that all electrical and piping connections are properly made; and that lubricants have been provided and installed.

3.3 INSPECTION AND START-UP

- A. The Contractor shall furnish a representative of the manufacturer to perform inspection, start-up and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment and shall instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. The representative shall check the installation and supervise initial start-up of the equipment, and shall perform, at a minimum, the following tests on each pump:
 - 1. Measure and record shutoff head and power draw at shutoff head.
 - 2. Measure and record actual operating head and power draw at actual operating head.

3. Measure and record operating head and power draw at two separate partially throttled flow rates.
 4. Measure and record static head.
 5. Duplicate all normal operating modes and all failure modes, including the removal and installation of pumps from the wet well using the guide rail system.
- B. The Contractor shall furnish a representative of the manufacturer to perform inspection, start-up and training services for the pump control system. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment and shall instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. The representative shall check the installation and supervise initial start-up of the equipment.
 - C. Contractor shall verify that the pumps are operating at the design duty condition, and shall remove and replace units that do not meet the design operating criteria.
 - D. For all pump tests, ensure that the force main is full of liquid during the testing. The Contractor shall provide the necessary water and other materials required for the testing as defined herein and recommended by the manufacturer.
 - E. The manufacturer's representative shall provide written certification that the installation is correct and that the equipment has operated satisfactorily, verifying the complete assembly for proper alignment and connection, and quiet operation. This service shall be provided for a minimum period of one trip and one day. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the Owner's personnel in the proper operation and maintenance of the equipment. The Owner may videotape the training.
 - F. A start-up report, acceptable to and approved by the Engineer, shall be completed by the manufacturer's representative before final acceptance of the pumps.

3.4 FIELD QUALITY CONTROL

- A. Provide manufacturer's certifications verifying proper installation and operation of the pumps and pump assemblies.
- B. Replace pumps and assemblies that fail testing or are otherwise damaged at no additional cost to the Owner.
- C. The Contractor shall bear all costs of field tests, including related services of the manufacturer's representative.

END OF SECTION